Orthopantomograph® OP30

Digital Panoramic X-ray Unit

Service manual

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Manufactured by

Instrumentarium Dental
Nahkelantie 160 (P.O. Box 20)
FI-04300 Tuusula
FINLAND
Tel. +358 (0)10 270 2000
Fax. +358 9 851 4048

For service, contact your local distributor.

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Contents

1. General Information 1
1.1 Introduction 1
1.2 Associated documentation 1
1.3 Service precautions and warnings 1
Servicing precautions 1
Warning - Radiation Safety 2
Warning - Mechanical safety 2
Warning - Electrical Safety 2
Caution - electrostatic discharge 3
Warning - Explosion hazard 4
Warning - Cleaning the unit 4
1.4 Unauthorized Modifications 4
1.5 Disclaimer 4
1.6 Yearly maintenance 5
mA test 5
kV test 6
Beam alignment test 6
Ground test 6
Motor movements 7
Position detectors 7
Patient Positioning Lights 7
Mains power supply cable 7
Tubehead 8
Covers and Labels 8
Fire risk 8
1.7 Disposal 9
2. Unit description 10
2.1 The Orthopantomograph® OP30 10
2.2 The main parts and assemblies 11
2.3 Unit dimensions 14
2.4 Mechanical description 15

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

2.5 Electrical description 17
Circuit boards 17
Power supply 17
Main fuses 17
Unit control 18
Motors and motor control 18
Exposure logic 19
Position control 20
A overview of the Imaging Chain 20
2.6 Wiring diagram - overview 23
2.7 Block diagram 24
2.8 Fuse diagram 25
3. Circuit Boards 27
3.1 L100, Z-Motor Driver 27
3.2 L200, CCD Power Supply 37
3.3 L900, Display adapter 47
3.4 L1000, Generator Board 58
DANGER: HIGH VOLTAGE 58
3.5 L1100 Connector Board 66
3.6 L1200 CPU Board 76
3.7 L1300 Interface Board 94
3.8 N2500 Rotation Position Sensor Board 99
3.9 R5100, 3-Phase Microstepper Driver 103
3.10 CCD Sensor / Filter board 107
4. Troubleshooting 110
4.1 Initial checks 110
Restarting the unit 110
Error Codes 110
Checking circuit boards 110
Checking cables and connectors 111
Power supply problems 111
4.2 Problems during start up 112
Nothing happens when the unit is switched on 112
The on/off switch light does not come on. 112
The on/off switch light comes on but the display does not come on. 112
Error E 5 (Line voltage out of limits) 114
Error E 18 (Display not connected) 114

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

4.3 Problems while preparing the unit for an exposure 115
Image of emergency button appears on main display 115
The side control panel Return key does not work 115
Error E 7 (Opto or r-motor failed during r-movement) 115
Rotating unit stop rotating, no error code 116
Patient positioning light(s) do not come on 116
One of lights does not come on. 116
None of the lights come on. 116
Up/down (Z-motor) keys do not work 117

4.4 Problems during exposure 119
Nothing happens when the exposure button is pressed 119
Error code H1 (Exposure interupted) 119
Error codes E0, E1 and E2 120
Error E 6 (Exposure timeout) 122
Error E 10 (CCD initialization/configuration failure) 122
Error E 11 (CCD power failure) 123
Error E 12 (CCD line failure) 123
Error E 13 (CCD DMA failure) 123

4.5 Problems after exposure 124
Error E 4 (Tubehead too hot or too cold) 124
Vertical white stripes on the image 124
Horizontal white stripes on the image 124

4.6 Bad quality images 125
Incorrect patient positioning 125
A badly aligned unit 125
The CCD sensor is not calibrated 125

5. Service Assistant and service functions 126

5.1 Using the Service assistant 126

5.2 The Service commands 128

6. Updating unit firmware, core and display graphics 138

6.1 The unit firmware 138

6.2 Updating the core 140

6.3 Updating the GUI graphics 141

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

7. Replacing parts. 142
7.1 Removing covers 142
7.2 Replacing the tubehead 143
7.3 Replacing the CCD sensor 146
7.4 Replacing the collimator 146
7.5 Replacing circuit boards 146
L900 Display adaptor - additional instructions 146
L1000 Generator board - additional instructions 147
L1100 Connector board - additional instructions 147
L1200 CPU board - additional instructions 147
8. Aligning the unit 148
8.1 Removing the covers 148
8.2 Checking and Aligning the CCD Sensor 148
8.3 Checking and adjusting the position of the collimator 150
8.4 Checking and adjusting the Chin Support 153
8.5 Checking and adjusting the focal trough 155
8.6 Recheck the alignment 157
8.7 Calibrating the CCD sensor 157

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
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1. General Information

1.1 Introduction

This manual describes how to service the Orthopantomograph® OP30 Digital Panoramic X-ray Unit (the unit).

1.2 Associated documentation

The unit user's manual.
The unit installation manual.
The unit spare-parts manual.

1.3 Service precautions and warnings

Servicing precautions

Only service personnel trained and approved by Instrumentarium Dental are allowed to service the unit.

Before attempting to service the unit make sure that you know how to operate it. Read the unit user's manual.

Read and familiarize yourself with the warnings and precautions listed in the unit user's manual.

Only use original Instrumentarium Dental spare parts when repairing the unit or replacing parts.

The unit is factory set to operate using **either**:
- 100 VAC or
- 115 VAC or
- 220 VAC or
- 230 VAC or
- 240 VAC

The voltage of the unit can be found on the type label. Never connect the unit to a power supply different to the voltage marked on the type label.

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Warning - Radiation Safety

Before servicing the unit familiarize yourself with local and national radiation safety standards and requirements relating to dental x-ray equipment.

When taking test exposures take adequate precautions to protect yourself from radiation. Stand behind a suitable radiation shield positioned at least two metres (six feet) from the unit.

Warning - Mechanical safety

Disconnect the unit from the main power supply before removing any covers.

Disconnect the unit from the main power supply before repairing or replacing mechanical parts or installing accessories.

Be careful when operating the unit not to get body parts or clothing trapped between moving parts.

During operation some surfaces and components may become hot. Take precautions to avoid burning yourself.

The aperture plate in the collimator is made of lead (Pb) which is toxic. Do not touch it with your bare hands.

Do not open the tubehead. There are no serviceable parts, mechanical or electrical, inside the tubehead.

Warning - Electrical Safety

Disconnect the unit from the main power supply before replacing circuit boards or other electrical components.

If there are capacitors on a circuit board or electrical component wait ten (10) minutes, after disconnecting the unit from the power supply, before handling the board or component.

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D504851

If you have to leave the unit unattended during servicing or maintenance, disconnect the unit from main power supply to protect people, who may touch the unit, from electric shock.

This unit should be used only in areas that are provided with a protective earth connection to ensure an equipotential ground connection.

Caution - electrostatic discharge

Electrostatic Discharge (ESD) can damage or destroy electronic components.

When servicing the unit take precautions to avoid electrostatic build up and discharge (ESD). Follow the recommendations for the prevention of ESD that are used in the country in which you are working. If no recommendations are available, follow the guidelines below:

- Leave all new or replacement circuit boards and electrical parts in their protective packaging until the boards are needed.

- Before handling circuit boards and electrical parts make sure that any static electricity charge that has built up in you body is discharged.

- When examining and checking circuit boards use an antistatic wrist wrap which is connected to a ground point through a 1 Mohm current limiting cable. For a ground point use water pipes, radiators or other objects that are known to be connected to the ground. Also use a cable to connect the unit to the same ground potential as the wrist wrap.

- When handling circuit boards hold them by their edges and do not touch any components or connectors.

- If an antistatic mat is used, connect the wrist wrap to the mat and the mat to the ground potential.

- Wash the wrist wrap and check that it is in good condition frequently.

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Approved
D504851

Warning - Explosion hazard

Certain disinfectants and cleaning agents may vaporize to form an explosive vapour. If such chemicals are used the vapour should be allowed to disperse before switching the unit on.

Warning - Cleaning the unit

Switch the unit off and disconnect it from the main power supply before cleaning or disinfecting the unit.

1.4 Unauthorized Modifications

Unauthorized changes or modifications to any part of the unit or its equipment can have hazardous consequences. Changes or modifications must not be made unless specifically authorized by Instrumentarium Dental.

When properly assembled with a compatible beam-limiting unit, the diagnostic source assembly will fully meet the United States of America Federal Performance Standards for Diagnostic X-Ray Systems and Their Components (21 CFR 1020. 30-32) provided no components or parts are removed from the unit and no unauthorized adjustments are made to the beam-limiting unit or tube housing assembly.
Never remove or remanufacture any part of the tube housing assembly or beam-limiting unit.
Never adjust any part of the beam-limiting unit unless under the direction of Instrumentarium Dental or their authorized distributor.

1.5 Disclaimer

Instrumentarium Dental shall have no liability for consequential damages, personal injury, loss, damage or expense directly or indirectly arising from the use of its products. No agent, distributor or other party is authorized to make any warranty or other liability on behalf of Instrumentarium Dental with respect to its products.

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1.6 Yearly maintenance

The following tests and inspections must be carried out annually by an authorized service person to verify that the unit meets the specifications and performance criteria essential for correct and safe operation.
When taking measurements that require a multimeter, always use a digital multimeter (DMM).

mA test

WARNING: X-rays are generated when this test is carried out. PROTECT YOURSELF FROM RADIATION.

1. Connect the +probe of a DMM to test pin TP18 (mAfb) and the -probe to TP17(GND) on the Generator board.

2. Select service command **exp** and an exposure time of 2000 ms (refer to section 4 Service assistant and service functions, in this manual).

3. Protect yourself from radiation and take an exposure. Check the feedback values from the DMM. The feedback values must be within the tolerance.

Selected mA	mAfb (V)	Tolerance (V)
10	2	±0.2 (1.8 - 2.2)

If the value is not within the tolerance, recalibrate the Generator board, see section 5.2 Service Commands (the **calib** command).

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kV test

WARNING: X-rays are generated when this test is carried out. PROTECT YOURSELF FROM RADIATION.

1. Connect the +probe of a DMM to test pin TP14 (kVfb) and the -probe to TP17(GND) on the Generator board.

2. Select service command **exp** and an exposure time of 2000 ms (refer to section 4 Service assistant and service functions, in this manual).

3. Protect yourself from radiation and take an exposure. Check the feedback values from the DMM. The feedback values must be within the tolerances.

Selected kV	kVfb	Tolerance (V)
66	3.0	±0.2 (2.8 - 3.2)
77	3.5	±0.2 (3.3 - 3.7)

If the values are not within the tolerances, recalibrate the Generator board, see section 5.2 Service Commands (the **calib** command).

Beam alignment test

Check the beam alignment. Refer to the Installation and set-up manual for information on how to do this.

Ground test

Disconnect the unit from the main power supply before carrying out this test.
For ME EQUIPMENT with an APPLIANCE INLET the impedance between the earth pin in the APPLIANCE INLET and any part that is PROTECTIVELY EARTHED shall not exceed 100 m ohm. The grounding resistance is measured between APPLIANCE INLET ground pin and any metal part of the unit.
The resistance MUST be <0.1 ohm.

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D504851

Motor movements

Switch the unit off and then manually rotate the rotating unit to check that all the stepper motor moves freely and without any looseness.

Switch the T-mode "test" and then take an exposure to check that the motors operate smoothly and without any noise.

Press the up/down keys to check the Z-motor (vertical carriage movement). The motor must operate smoothly and without any noise.

Position detectors

Press the up key and drive the unit up. Make sure that the unit stops moving at its uppermost position.
Press the down key and drive the unit down. Make sure that the unit stops moving at its lowermost position.

Manually rotate the rotating unit to one of its end positions and then press the return button and make sure that the rotating unit returns to the ready position. Repeat the test for the other end position.

Use service command **optotest**, see section 5.2 Service Commands, to check the rotating unit optosensors. Manually turn the rotating unit in one direction and then press return. Repeat for the other direction.

Patient Positioning Lights

Check that the patient positioning lights work and are positioned correctly. Refer to the Installation and set-up manual for information on how to do this.

Mains power supply cable

Check the condition of main power supply cable and replace it if damaged.

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Tubehead

Make sure that oil is not leaking from the tubehead. If the tubehead shows signs of oil leakage, replace it.

Covers and Labels

Check that all covers are correctly installed and in good condition. Also check that all the labels are attached to the unit and that they are all legible.

Fire risk

WARNING: Disconnect the unit from the main power supply before carrying out the next task.
Use a vacuum cleaner to remove all dust that has accumulated inside the unit to eliminate the risk of fire.

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1.7 Disposal

At the end of useful working life of the unit, its spare and replacement parts and accessories make sure that you follow all local, national and international regulations regarding the correct and safe disposal and/or recycling of the unit, its spare and replacement parts and accessories.

The unit and its spare parts and accessories may include parts that are made of or include materials that are non-environmentally friendly or hazardous. These parts must be disposed of in accordance with all local, national and international regulations regarding the disposal of non-environmentally friendly or hazardous materials.

The following hazardous materials and substances can be found in the unit, its spare and replacement parts and assemblies:

- Lead (Pb):
  circuit boards, tubehead, collimator
- Cadmium (Cd):
  none
- Mercury (Mg):
  none
- PBB Polybrominated biphenyls:
  none
- PBDE polybrominated diphenyl ethers:
  none

Other materials and substances in the unit, its spare parts and assemblies that could be hazardous and are non-environmentally friendly are:

- Mineral oil:
  tubehead

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2. Unit description

2.1 The Orthopantomograph® OP30

The Orthopantomograph® OP30 extraoral x-ray unit is designed to take exposures of the dento-maxillofacial region.
The unit cannot be used to take x-ray exposures of any other part of the human anatomy.

The unit can be used to take adult panoramic (full width), child panoramic (reduced width), TMJ and bitewing images.

The unit is factory set to operate using **either**:
- 100 VAC or
- 115 VAC or
- 220 VAC or
- 230 VAC or
- 240 VAC power supply.

The voltage setting CANNOT be changed.

The unit is used with a PC in which Cliniview or some other MDD approved dental imaging software is installed.

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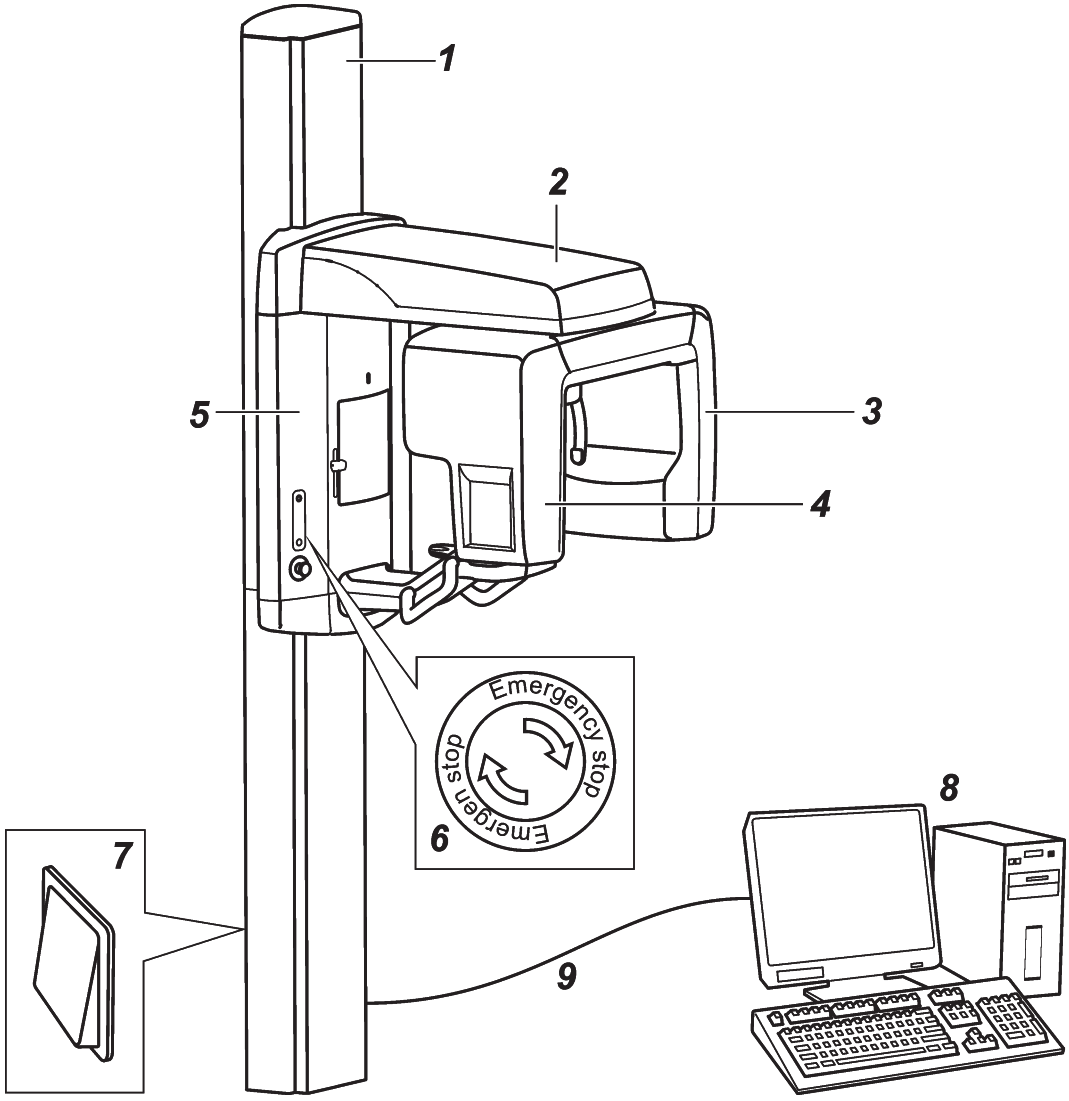
2.2 The main parts and assemblies



1 Column
2 Upper shelf
3 Tubehead
4 CCD sensor
Tubehead (3) + CCD sensor (4) = **Rotating unit**
5 Vertical carriage
6 Emergency stop button - Press to stop, rotate to release.
7 On / off switch (rear of column)
8 PC with MDD approved dental imaging software
9 Ethernet cable

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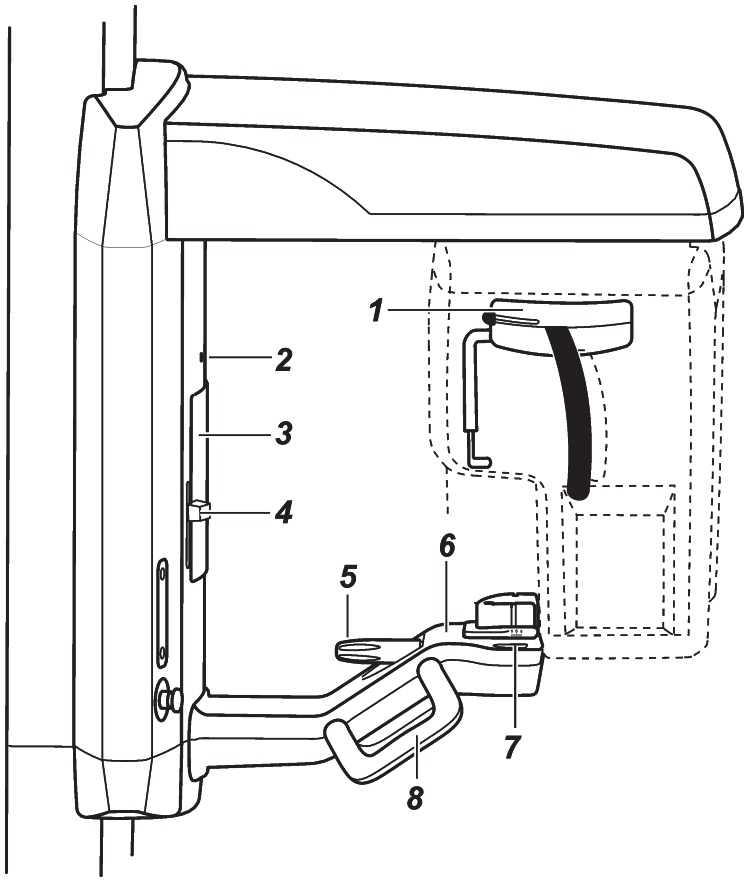

1 Head support
2 Midsaggital light
3 Mirror
4 Frankfort light and light positioning knob
5 Focal trough positioning knob
6 Patient support
7 Focal trough light
8 Patient support handles

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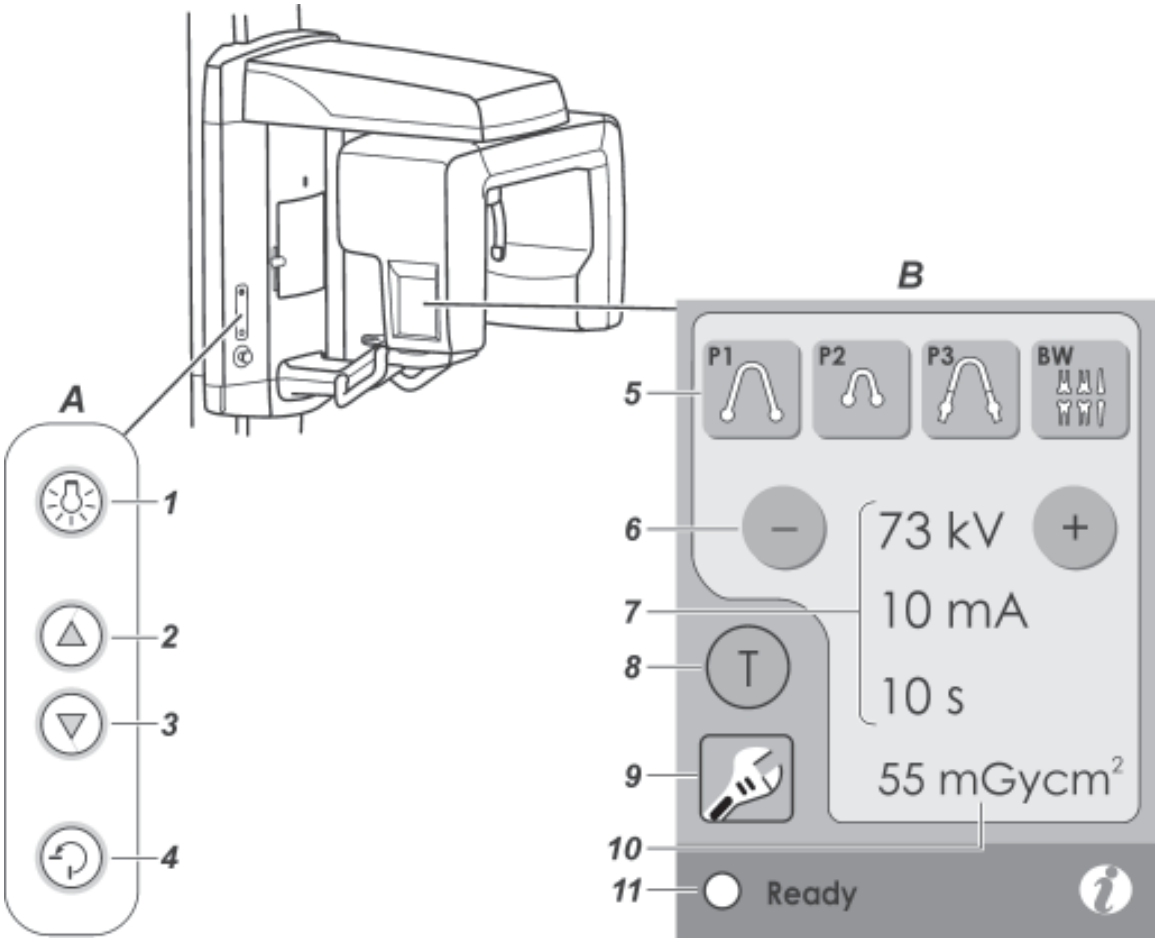

A side control panel

1 Lights key - switches the patient positioning lights on and off
2 Up key - drives the unit up
3 Down key - drives the unit down
4 Return key - drive the unit to the patient in/out position (PIO)

B main control panel

5 Program selection keys - P1 = adult pan, P2 = child pan, P3 = TMJ, BW = bitewing
6 kV selection keys
7 Exposure values
8 Test key - operated the unit without x-rays
9 Service mode key
10 Dose Area Product (DAP)
11 Ready indicator light - unit ready for an exposure

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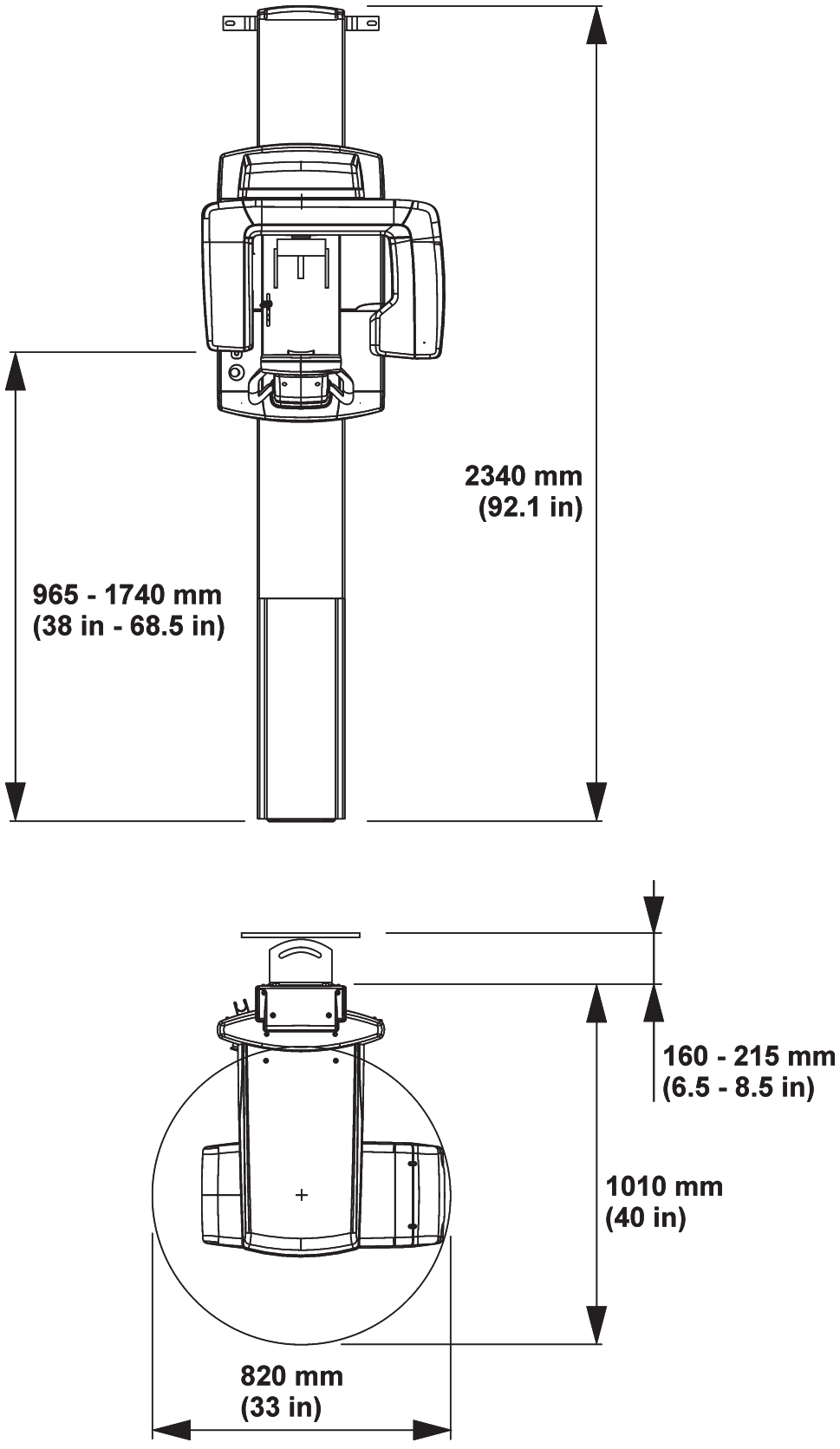
2.3 Unit dimensions



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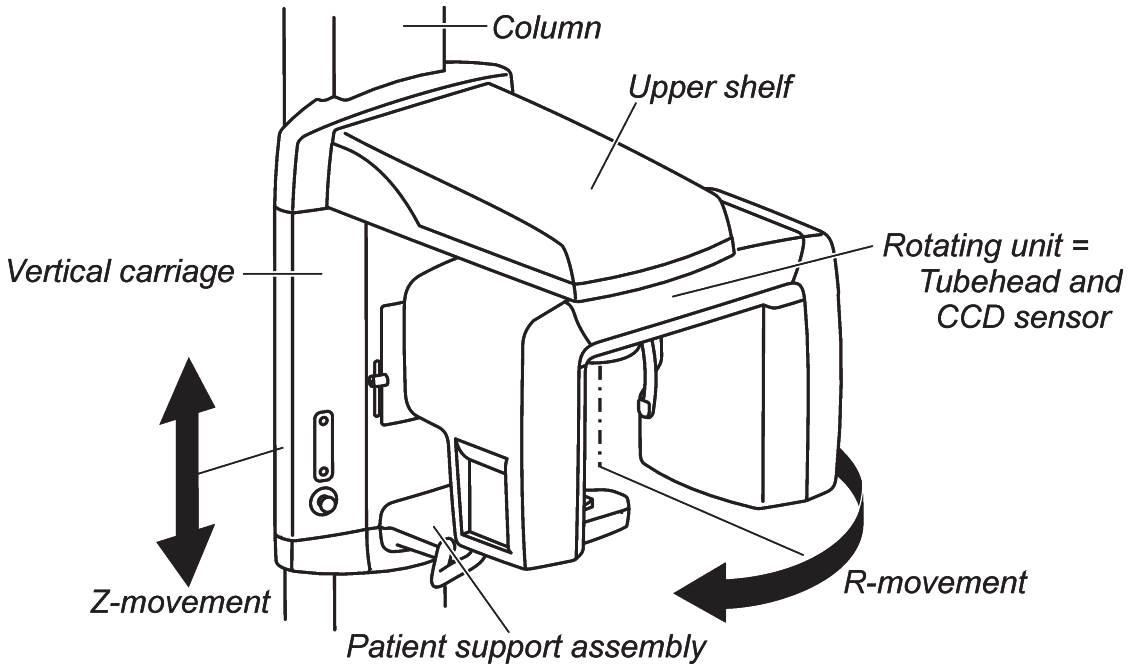
2.4 Mechanical description

The unit comprises a **column**, a **vertical carriage**, an **upper shelf**, a **rotating unit** and a **patient support assembly**.

The **column** is permanently fixed to the wall, using wall bracket, and the floor.
If the unit needs to be free standing it can be attached to the show stand (part no. 9802666).

The **vertical carriage** is attached to the **column** and can slide up and down the **column** (Z-movement, for unit height adjustment). The **upper shelf** is attached to the top of the **vertical carriage**.

The **rotating unit**, which comprises the tubehead and collimator and the **CCD sensor** assembly, is attached to the underside of the upper shelf. The **rotating unit** rotates to take panoramic exposures (R-movement).



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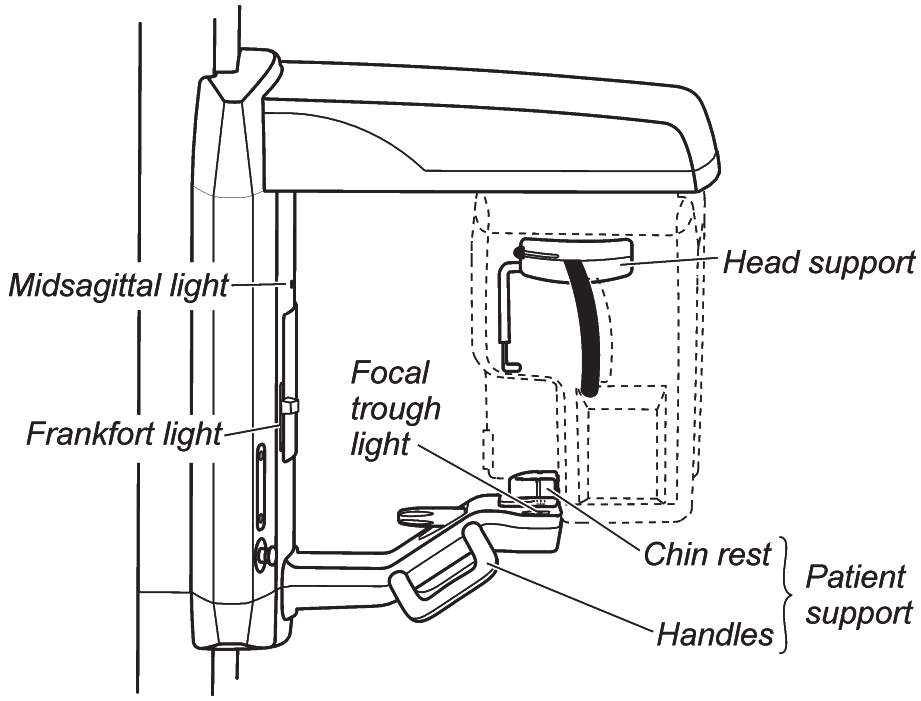
Inside the **tubehead** there is the x-ray tube. It is a fixed tungsten anode type with a focal spot of 0.5 mm.

The **patient support assembly** is attached to the bottom of the vertical carriage. It comprises **handles** for the patient to hold and a chin support.

The patient is held in position with a four-point support system. The **head support** (attached to the rotating unit) supports the patient's head with temple supports and the forehead support. The **patient support** supports the patients lower jaw on the chin support, using either the chin rest or lip support.

There are three patient positioning laser lights, **midsagittal light**, **Frankfort (horizontal) light** and **focal trough**.



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2.5 Electrical description

Circuit boards

Circuit boards are described in detail in section **3. Circuit Boards**.

Power supply

Power is supplied to the unit through L100 (Z-Motor Driver). The 230 VAC is is supplied directly to L100. Other voltages, 100, 115, 220, or 240 VAC, go through an autotransformer that first transforms these voltages to 230 VAC.
From L100, power is routed through the Generator board to a transformer which produces low voltages that are supplied to L200, a linear mode power supply, which distributes the low voltages to the other boards in the unit. The transformer also produces 27VAC and 19VAC voltages that are supplied directly (not through L200) to the Generator board.

The power for the AC-motor (z-motor), 230 VAC, is taken directly from L100 and not from the Generator board.

Capacitors on the Generator board produce the 310V needed to power the tubehead from the 230VAC supplied by L100.

Main fuses

Two:

- T6.3 H, SPT **(220/230/240 VAC)** or
- T10A, SPT **(100/115 VAC)**.

Dimensions 5 mm x 20mm, UL approved.
They are located below the main power supply cable at the rear of the column.

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Unit control

The unit is controlled by a microprocessor on L1200 (CPU board). It continually monitors and controls the operation of the unit. A serial peripheral interface communication protocol (SPI - RS485) and direct digital I/O are used to monitor most of the unit functions.
The microprocessor:
- monitors the optosensors
- monitors control (touch) panel keys
- controls unit movements during exposures
- starts, controls and stops x-ray generation
- controls the digital imaging chain

The necessary unit settings and parameters for all the imaging programs are stored in the memory which is also on L1200.

Motors and motor control

There is one stepper motor and one AC-motor in the unit. The stepper motor drives the rotating unit (R-movement). The stepper motor is driven and controlled by R5100 (3-Phase Microstepper Driver).

The AC-motor (Z-motor) adjusts the height of the unit (Z-movement), and the motor is activated by L100. To activate the Z-motor L100 must receive a control signal from L1200 and a separate control (enable) signal from the Z-movement (up/down) keys.
An emergency switch on the front of unit disables the Z-motor (Z-movement) and stepper motor (R-movement) when pressed.

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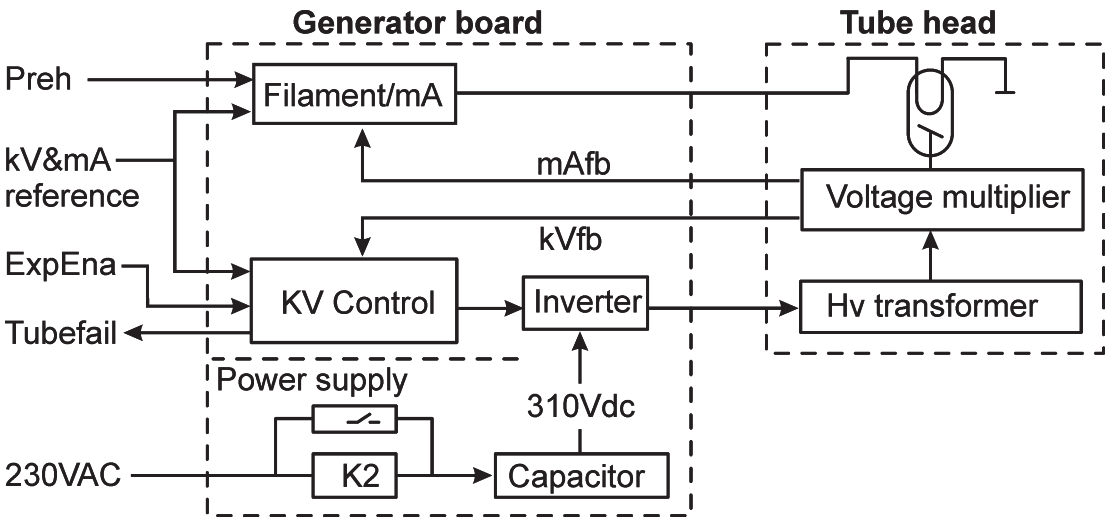
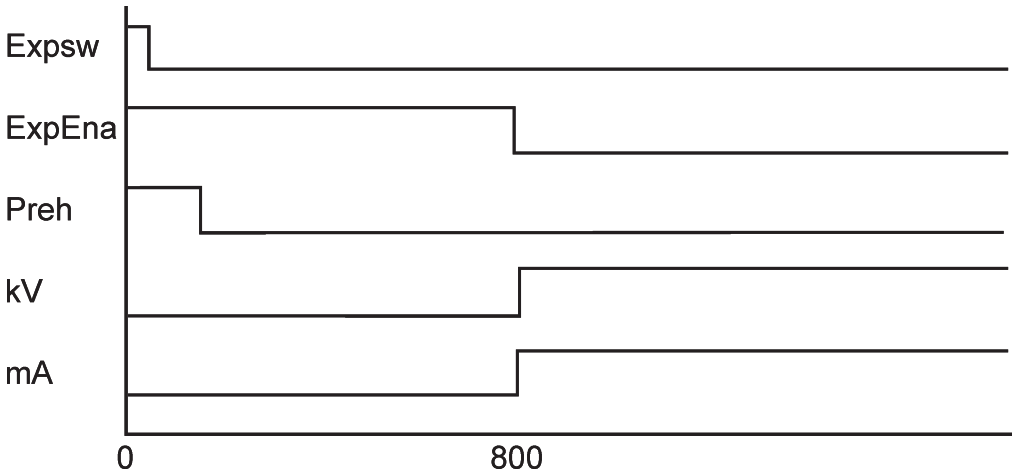
Exposure logic

An exposure can only be taken when the unit is in the ready state (the exposure ready light on the control panel is on) and the exposure button is pressed and held down. The Generator board receives the correct kV and mA references from the CPU. A few milliseconds after the exposure button is pressed (Expsw) preheat is enabled (Preh). After 800ms the exposure will start (ExpEna). The tubehead will receive power from the Generator board and the Generator board will also start to regulate the mA and kV according to mA- and kV- feedback.





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Position control

The position of the rotating unit (R-movement) is monitored by optosensors on N2500 (Rotation Position Sensor Circuit). The optosensors indicate in which sector the rotating unit is. The optosensors ensure that the rotating unit is in the correct position, start or PIO (Patient In/Out), for an exposure.
The statuses of the optosensors are monitored continually by the unit software.

The upper and lower limits of the vertical carriage (Z-movement) are monitored by microswitches.

A overview of the Imaging Chain

This description assumes that the unit is ready to take an exposure.

Image acquisition is controlled by the **DSD** software component which is installed in the PC connected to the unit.

When an exposure is taken L1200 (the CPU) then sends a PPOWER (pan) and CCDON signal. CCDON signal activates linear regulators on L200 which then produce the power supply voltages for the CCD sensor.

The CPU's control software continuously monitors the status of the connection with the DSD driver. After image exposure but before image transfer the CPU sends a label that includes the imaging parameters (—kV/—mA/—s) and an imaging program identifier.

The CPU enables the IMAGE signal to activate pixel clocking. The CPU then produces the TDI clock signal, which clocks the pixels from the CCD sensor. Derivation of several CCD clock signals from the TDI clock is done by the CCD sensor board.

Radiation striking the CCD sensor is converted to visible light which is detected by the CCD cell. A binning procedure is carried out on individual pixels, i.e. two adjacent pixels in a row and column (2 x 2 binning) forms one large pixel (96µm x 96µm). The output voltage of the CCD is fed to a 14-bit A/D converter.

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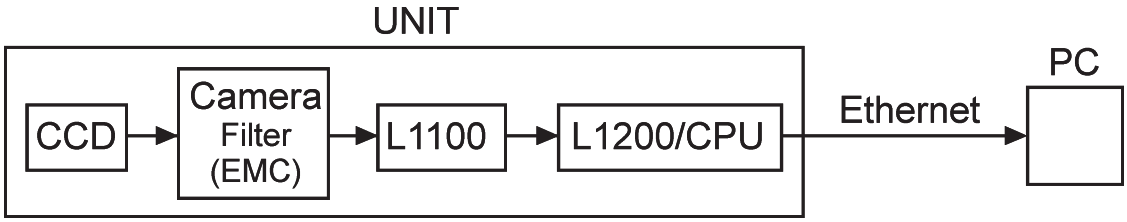
The CCD sensor board sends the image data (now 12 bits) to the CPU board where they are saved on the SDRAM. The image information is transferred to the PC via the Ethernet cable.



In the PC there is a Network Interface Card (NIC). After image data transfer the DSD preprocesses the raw image, for example it interpolates gaps between CCD chips, and carries out dark current correction and gain correction (the pixels do not have equal characteristics).

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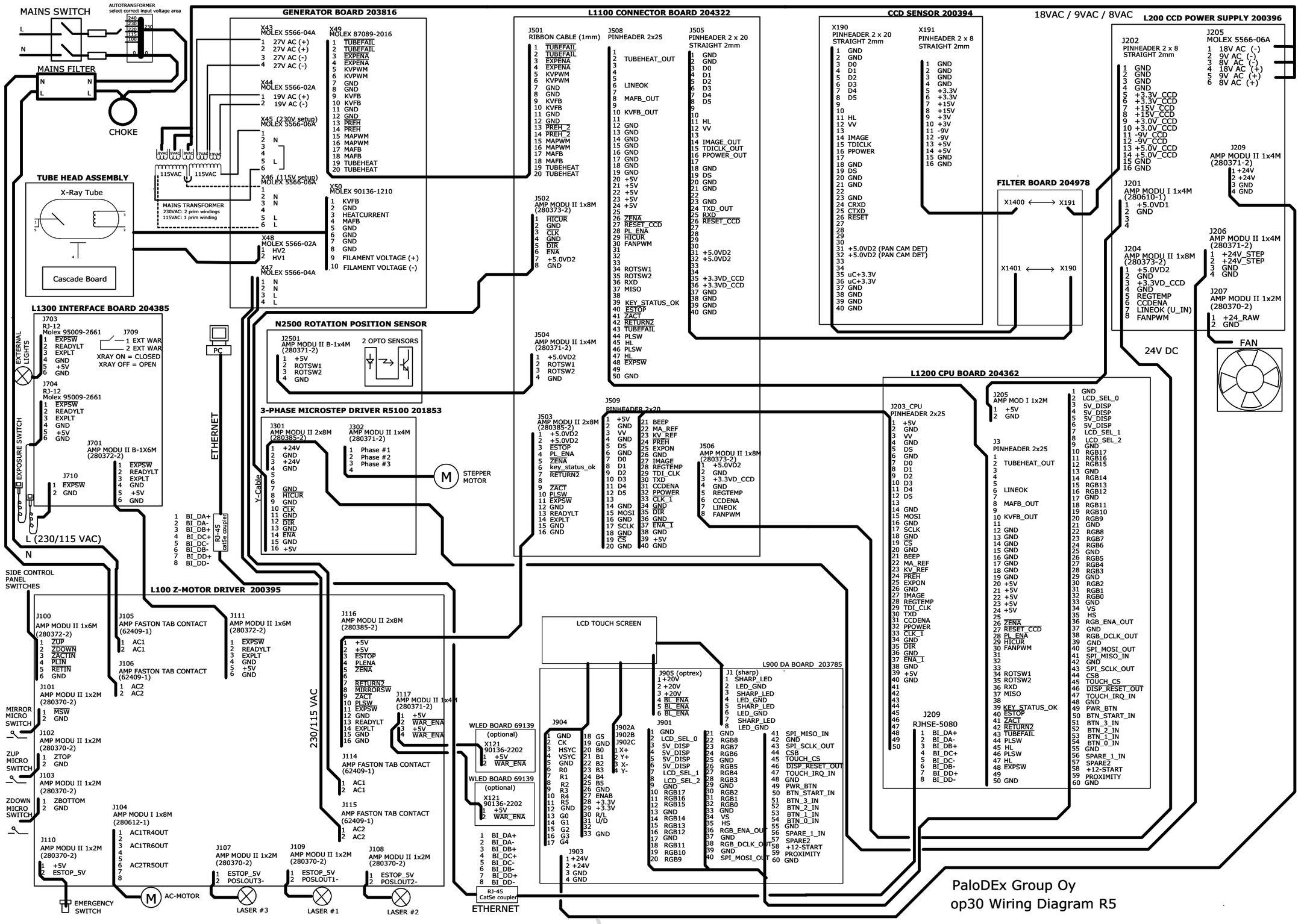
2.6 Wiring diagram - overview



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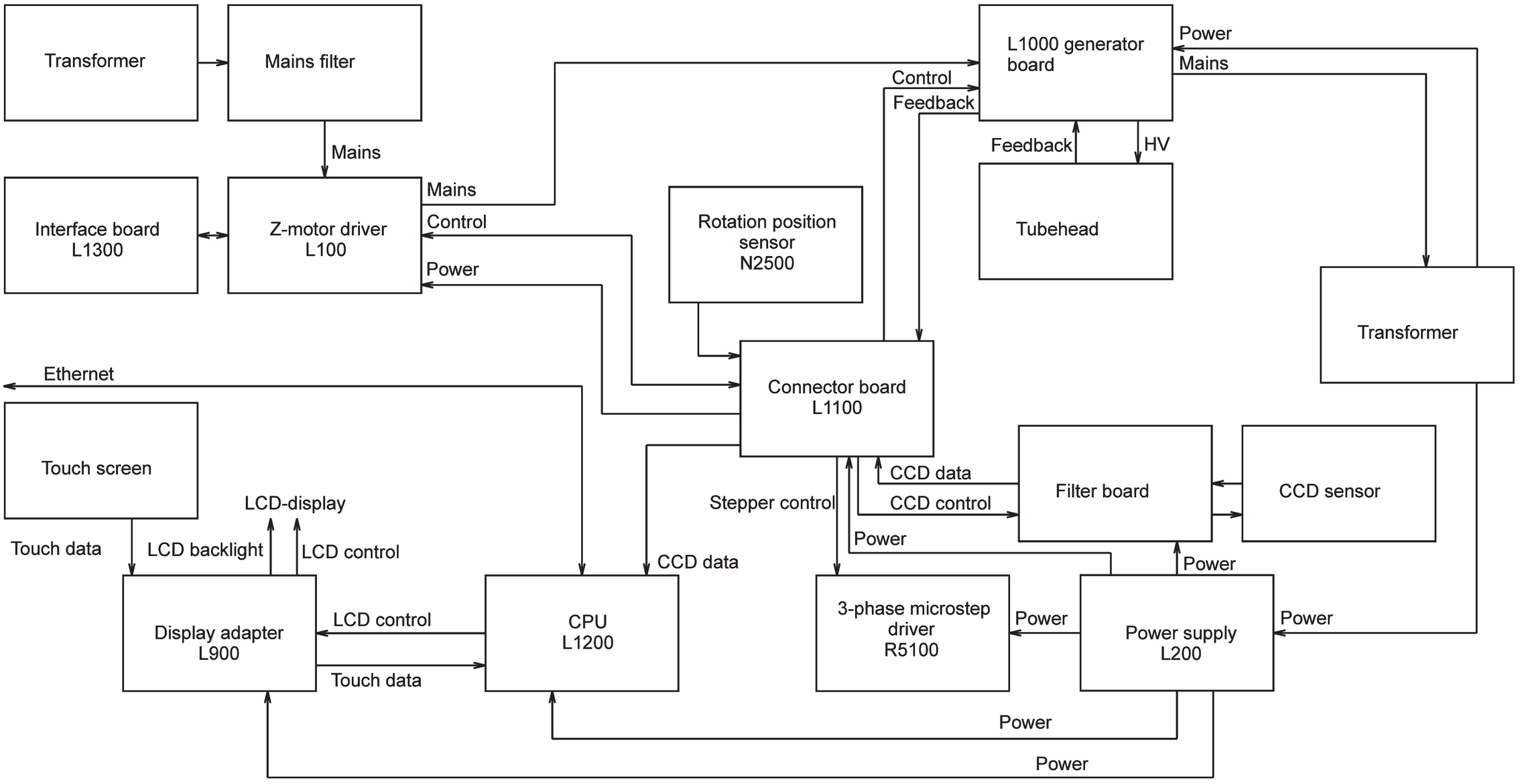
2.7 Block diagram



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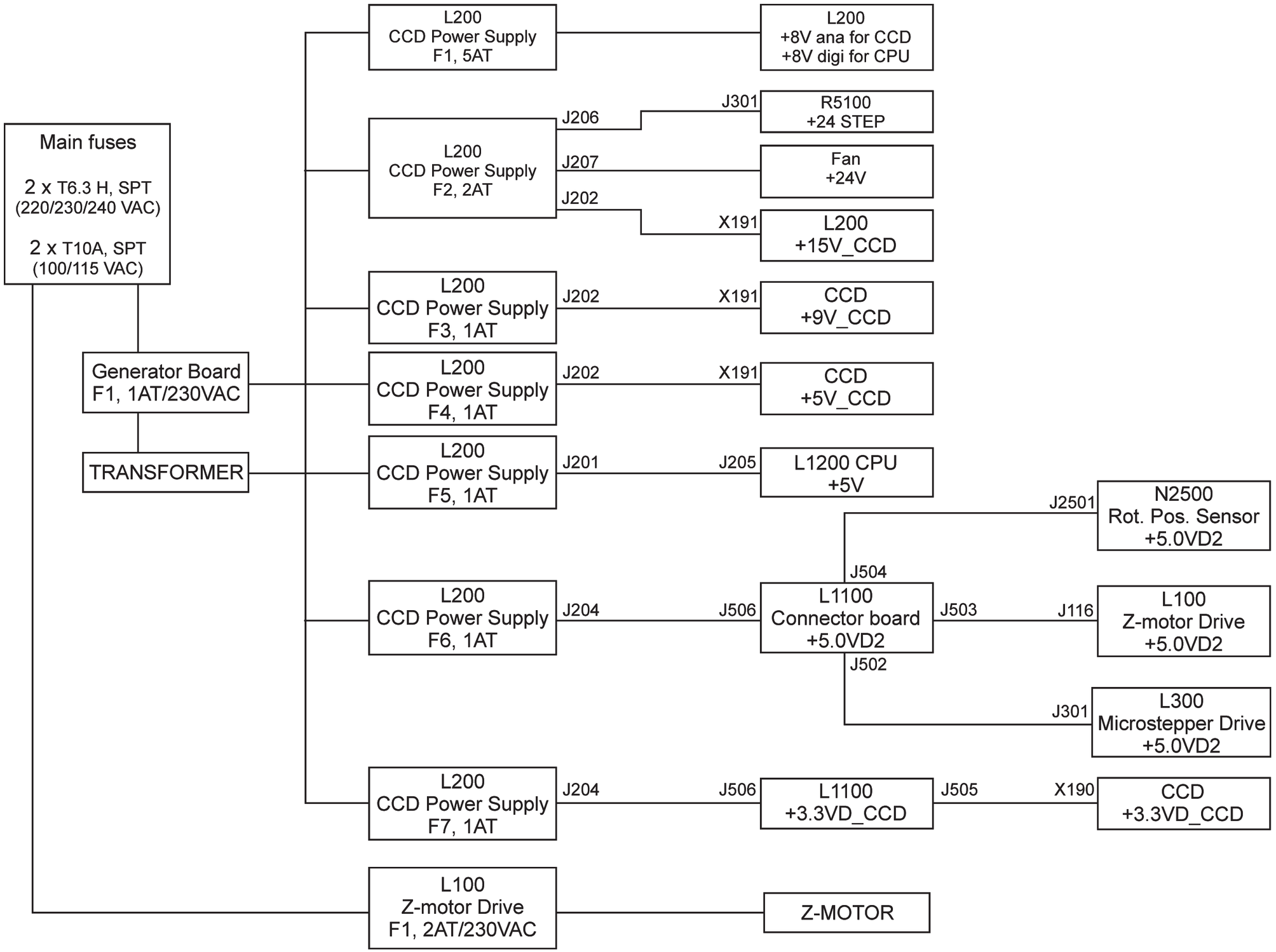
2.8 Fuse diagram



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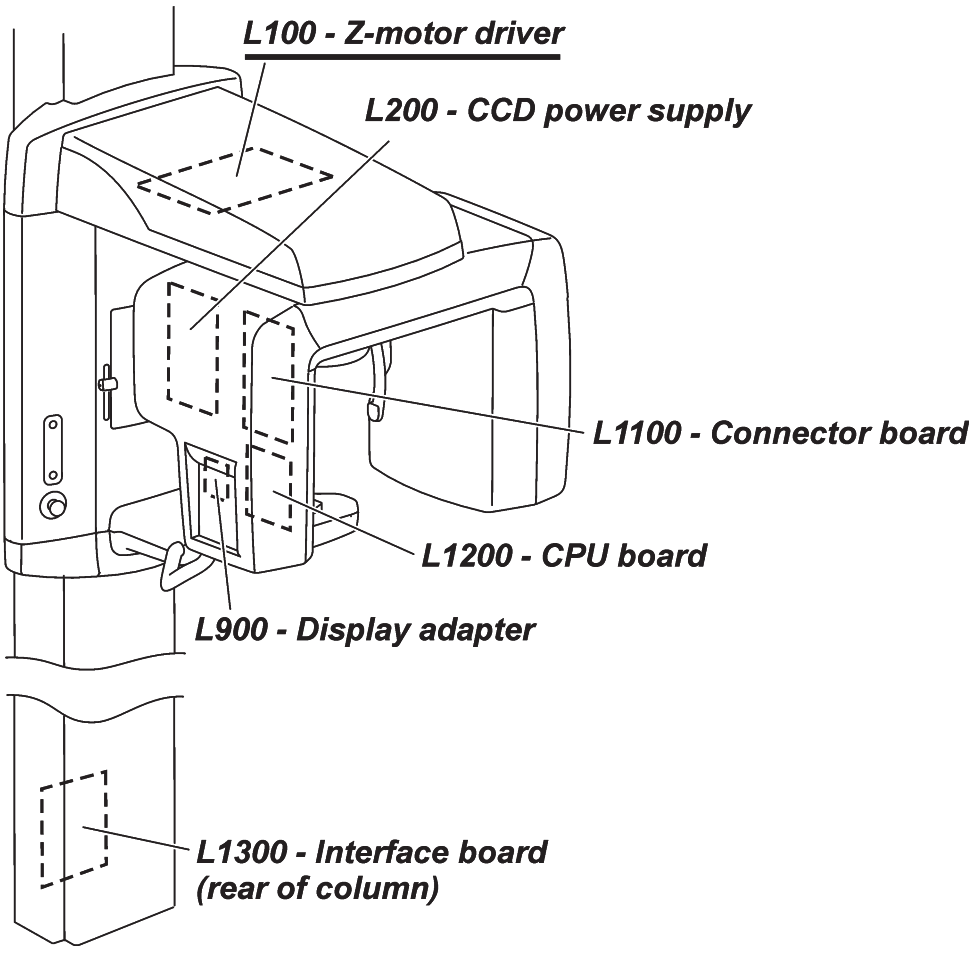
3. Circuit Boards

NOTE: An asterisk (*) after a signal name indicates an active low-level signal.

3.1 L100, Z-Motor Driver

L100 - Location

On the upper shelf.
To access remove shelf upper cover (see section 7.1).


L100 - Z-motor driver
L200 - CCD power supply
L1100 - Connector board
L1200 - CPU board
L900 - Display adapter
L1300 - Interface board
(rear of column)

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L100 - Field replaceable parts

Fuse F1.

NOTE:
The fuses used MUST be the approved type, UL listed and CSA certified.

Approved fuses:
- for units rated 230VAC:
2AT/250VAC Cooper Bussmann MDL-2

Dimensions 6.3 mm x 32 mm.

L100 - Description

L100 (Z-motor Driver) controls the AC-motor that drives the unit up and down. Membrane switches on the side of the vertical carriage are used to activate the AC-motor. The positions of the Z-carriage and the Rotating Unit are also monitored by L100.
Micro switches at the top and bottom of the column monitor the upper and lower positions of the Z-movement. Based on the logic on the circuit board, the movement of the AC motor is enabled or prohibited. Three triacs control the Z-motor currents. Outputs are opto-coupled from the user inputs with TLP3063 circuits. The board also includes light controls for the laser positioning lights.

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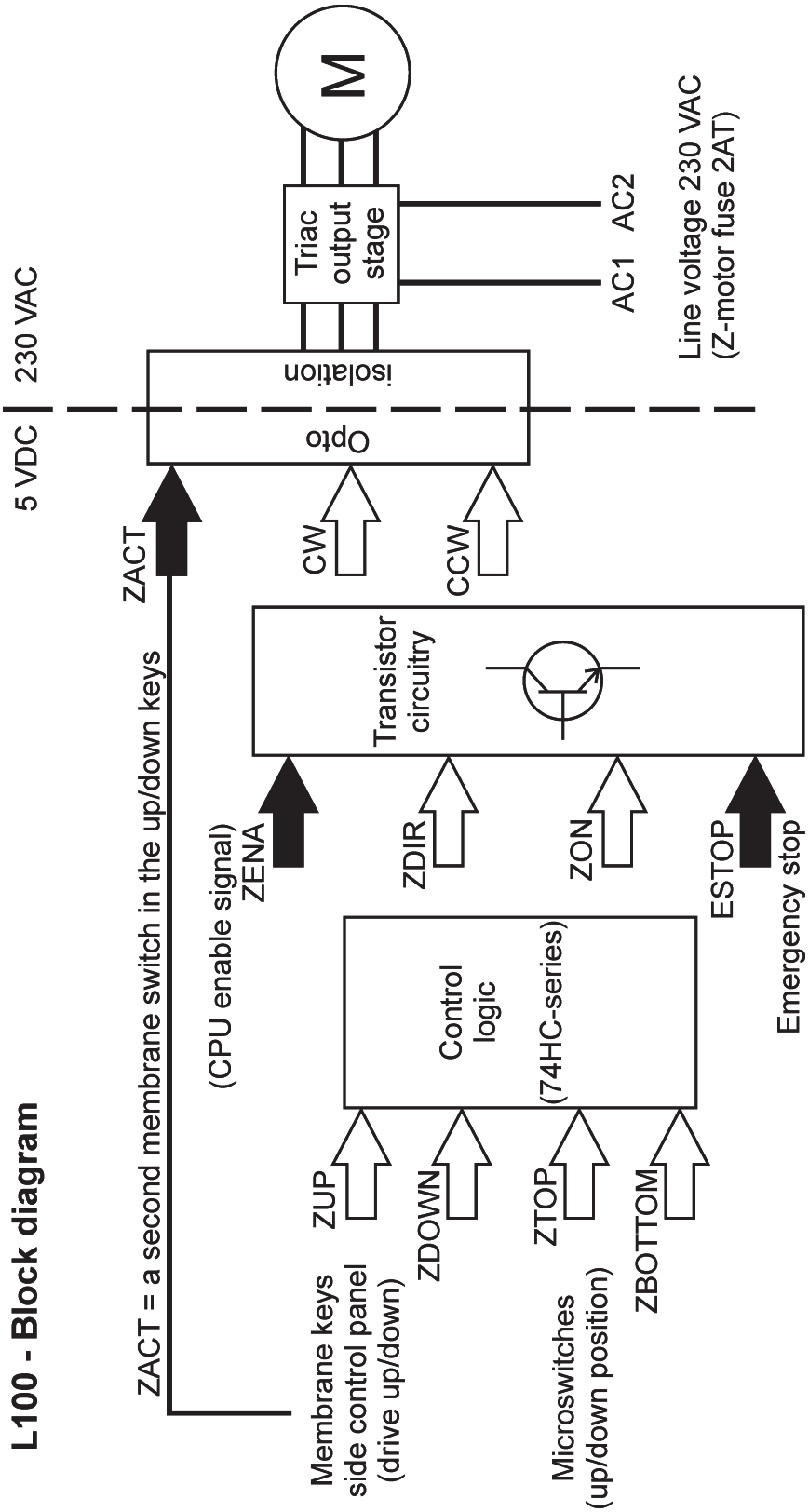
L100 - Block diagram



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L100 - Indicator lamp

Lamp	Function	Indicates
LA1 GLIM	AC indicator lamp	L100 receiving 230 VAC line voltage.

L100 - Indicator LEDs

LED	Colour	Indicates
D1	green	+5V on
D2	green	ZACT-movement key pressed
D3	green	ZON on
D4	red	ESTOP on. Emergency stop button is on.

L100 - Test Points

Number	Signal	Value
TP1	ESTOP_5V	+5V normally, 0 ... +0.5V when emergency switch pressed down
TP2	ZDIR	0V driving up, +4.8V...+5V driving down
TP3	ZON	**Text wrong (+5V)**. Correct value +3V when up/down key pressed. Otherwise 0V.
TP4	+5V	+5V
TP5	GND	0V
TP6	ZACT*	0 ... +0.5 when up/down key pressed, otherwise close to +5V.

L100 - Test Switches

DANGER - HIGH VOLTAGE!
Take great care when pressing the switches SW1, SW2, SW3 not to touch indicator lamp LA1 which is 230 VAC.

Switch	Operation
SW1 + SW2	Press simultaneously to drive vertical carriage up.
SW2 + SW3	Press simultaneously to drive vertical carriage down.

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L100 - Connectors

J100

Pin	Signal	Description
1	ZUP*	Z-movement drive up key pressed
2	ZDOWN*	Z-movement drive down key pressed
3	ZACTIN*	Z-movement key pressed
4	PLIN*	Position lights key pressed
5	RETIN*	Return key pressed
6	GND	Ground (logic)

J101

Not in use

J102

Pin	Signal	Description
1	ZTOP	Z-movement reached top
2	GND	Ground (logic)

J103

Pin	Signal	Description
1	ZBOTTOM	Z-movement reached bottom
2	GND	Ground (logic)

J104

Pin	Signal	Description
1	AC1TR4OUT	AC motor power signals
3	AC1TR6OUT	AC motor power signals
6	AC2TR5OUT	AC motor power signals

J105

Pin	Signal	Description
1,2	AC1	230 VAC line voltage

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J106

Pin	Signal	Description
1,2	AC2	230 or 115 VAC line voltage

J107

Pin	Signal	Description
1	ESTOP_5V	Emergency stop
2	POSLOUT3*	Position light 3

J108

Pin	Signal	Description
1	ESTOP_5V	Emergency stop
2	POSLOUT2*	Position light 2

J109

Pin	Signal	Description
1	ESTOP_5V	Emergency stop
2	POSLOUT1*	Position light 1

J110

Pin	Signal	Description
1	+5V	Supply voltage (logic)
2	ESTOP_5V	Emergency stop

J111

Pin	Signal	Description
1	EXPSW*	Exposure switch
2	READYLT	Ready light
3	EXPLT	Exposure light
4,6	GND	Ground (logic)

J114

Pin	Signal	Description
1,2	AC1	230 VAC line voltage

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J115

Pin	Signal	Description
1,2	AC2	230 VAC line voltage

J116

Pin	Signal	Description
1,2	+5V	Supply voltage (logic)
3	ESTOP*	Emergency stop on
4	PLENA	Position lights enable
5	ZENA*	Z-movement enable
7	RETURN2*	Rotating unit return
8	MIRRORSW	Mirror switch
9	ZACT*	Z-movement activity
10	PLSW	Position light switch
11	EXPSW*	Exposure switch
12,15,16	GND	Ground (logic)
13	READYLT	Ready light on
14	EXPLT	Exposure light

J117

Pin	Signal	Description
1,3	+5V	Supply voltage
2,4	EXPOSURE LT	Exposure light control

J118

Pin	Signal	Description
1	+5V	Power supply
2	GND	Ground
3	KEY_STATUS_OK	NOT USED
4	NC	NOT CONNECTED

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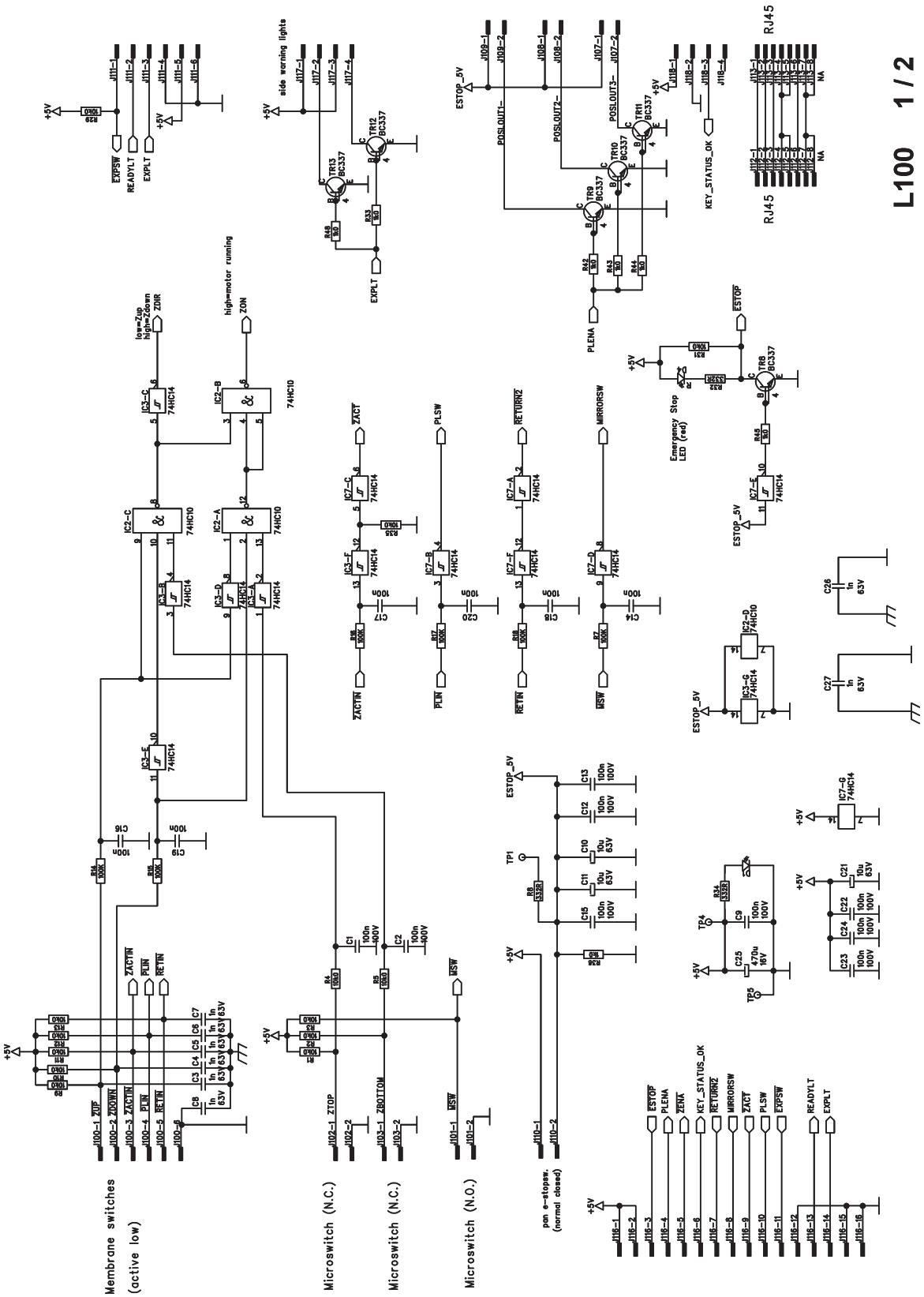

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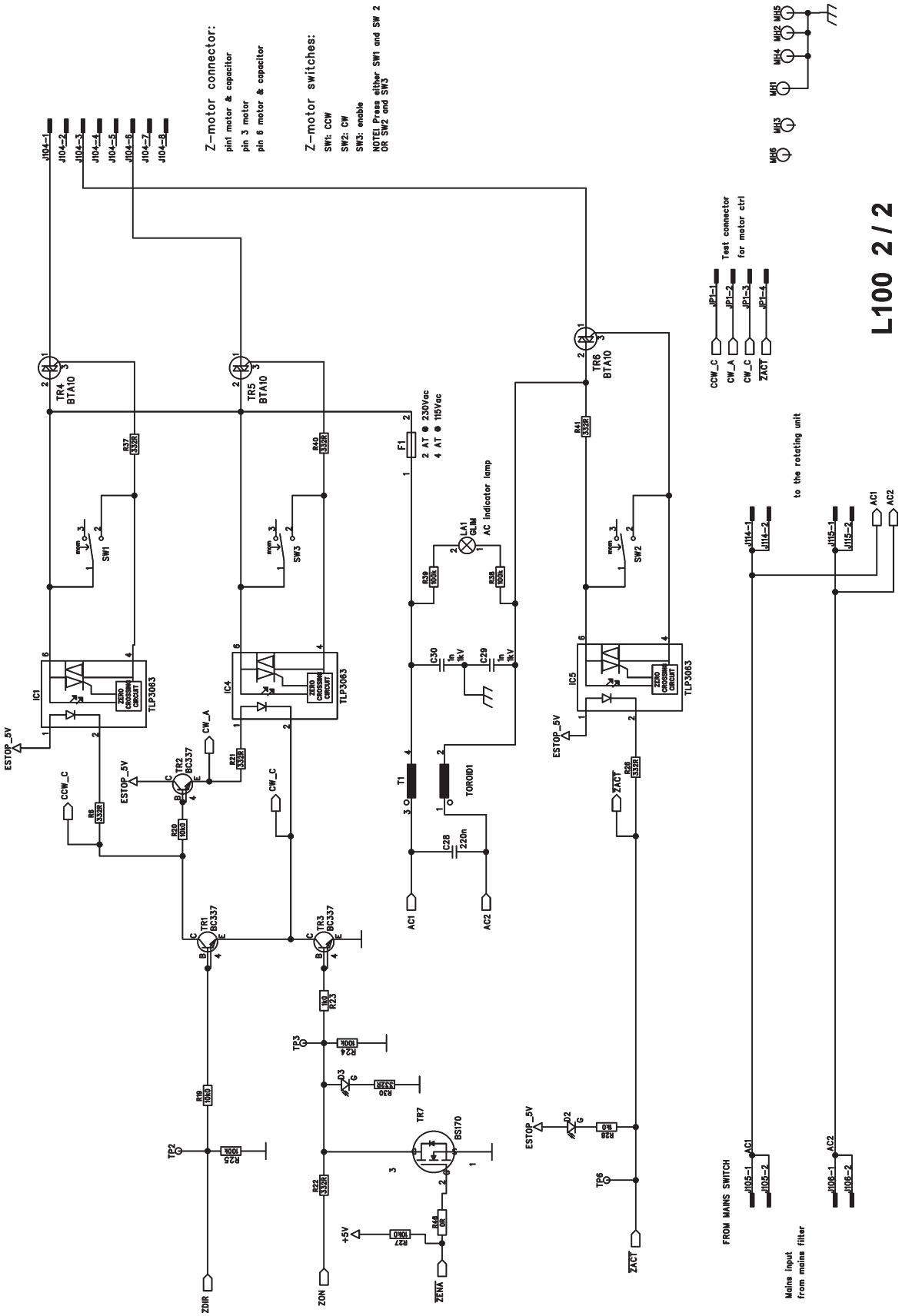

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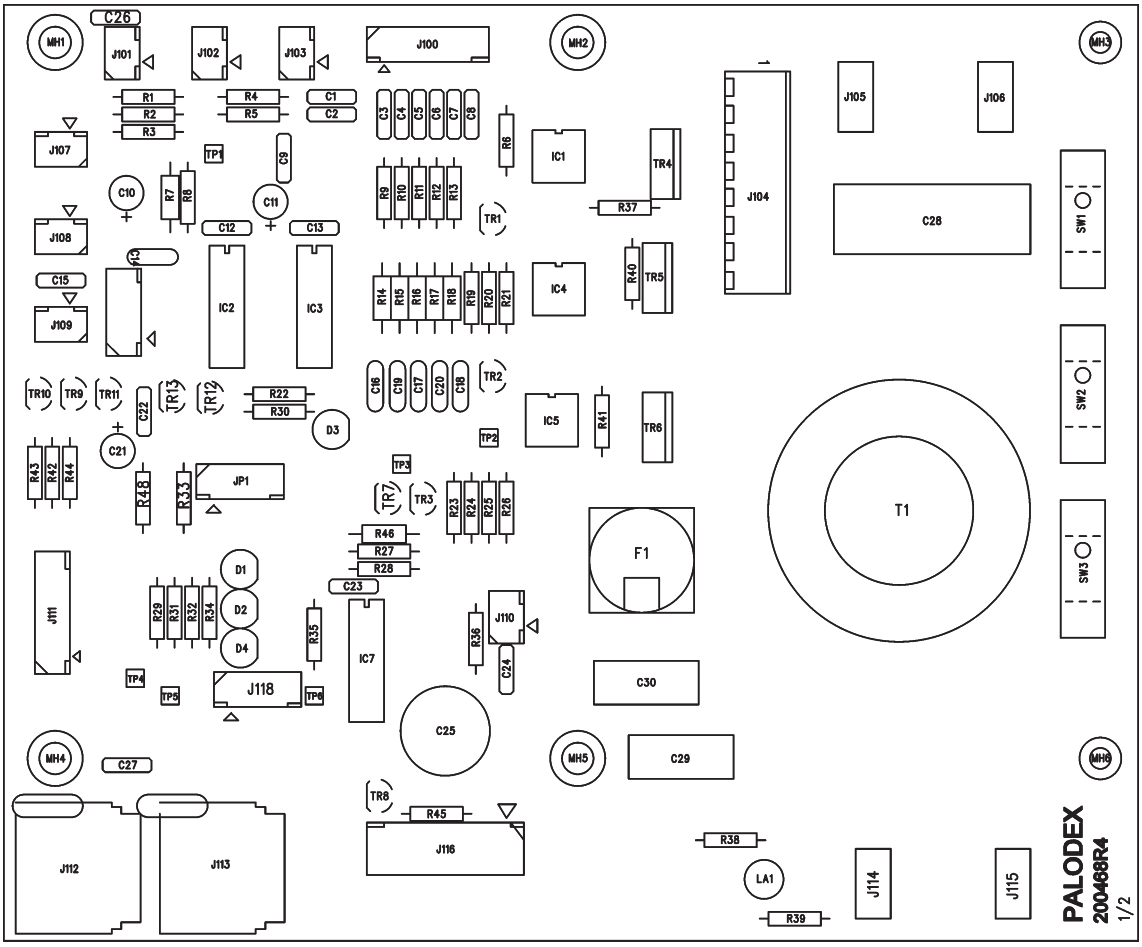

L100

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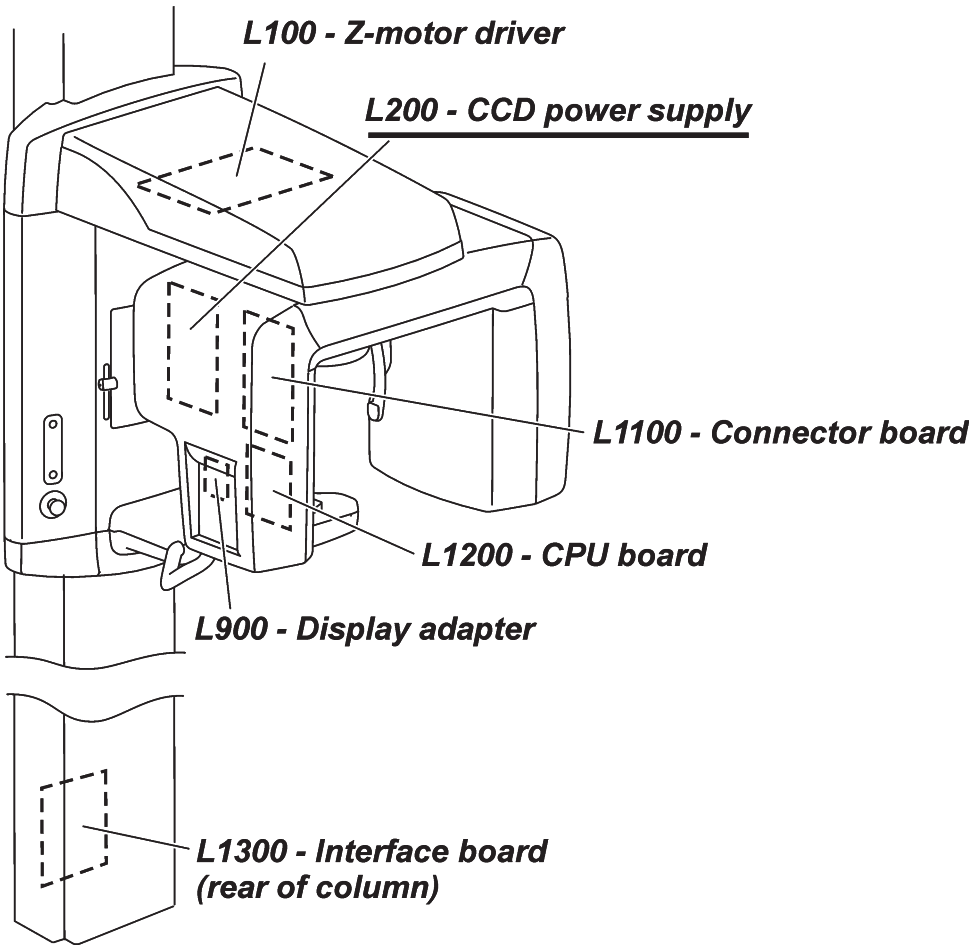
3.2 L200, CCD Power Supply

L200 - Location

In the rotating unit on the the CCD sensor side.
To access remove sensor external cover.
CAUTION:
The touch screen is attached to the cover. Disconnect (see section 7.1).


L100 - Z-motor driver
L200 - CCD power supply
L1100 - Connector board
L1200 - CPU board
L900 - Display adapter
L1300 - Interface board
(rear of column)

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L200 - Field replaceable parts

Fuse 1, 2 and 3

NOTE:
The fuses used MUST be the approved type, UL listed and CSA certified.

Fuse F1, 5AT/250VAC Cooper Bussmann S506-series
Fuse F2, 2AT/250VAC Cooper Bussmann S506-series
Fuse F3, 1AT/250VAC Cooper Bussmann S506-series

Dimensions, 5mm x 20mm.

L200 - Description

L200 supplies different voltages to most of the circuit boards in the unit. L200 receives three transformed AC voltages (18VAC, 9VAC, and 8VAC) from the Generator board, and rectifies and regulates them to produce the various voltages that the unit requires.
The CCD sensor require +3.3V, +3.3V, +3V, +15V, -9V, +5V.
The fan (it cools L200) and the 3-phase stepper motor require 24V.
L1200 and pheripheral electronics require two regulated 5VDC power supplies.

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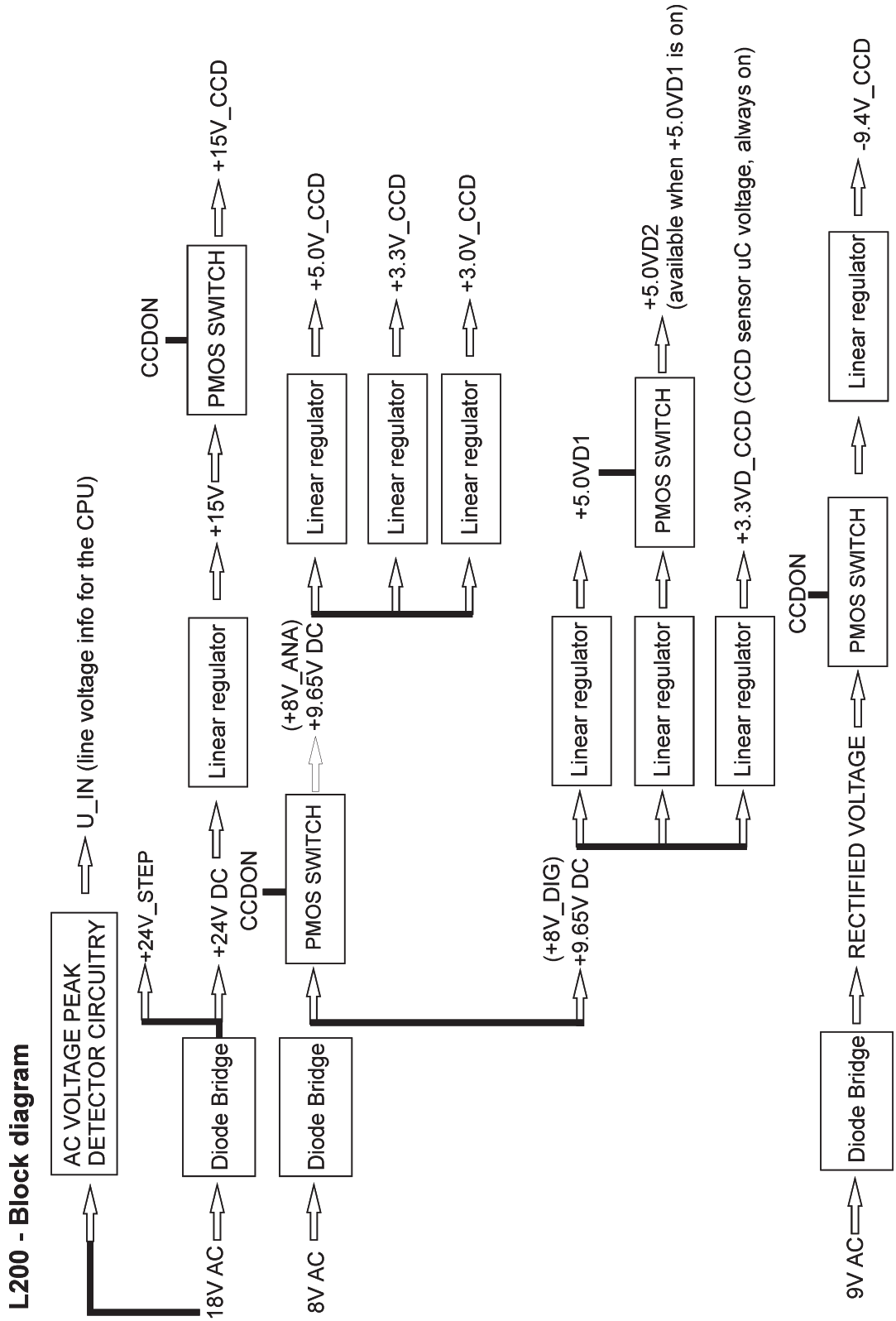
L200 - Block diagram



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L200 - Indicator LEDs

LED	Colour	Indicates
D1	green	+5.0VD1 on
D2	green	+5.0VD2 on
D3	green	+3.3VD_CCD on
D14	green	+15V on
D15	green	+3.0V_CCD on
D16	green	+5.0V_CCD on
D23	green	+3.3V_CCD on
D33	green	+15V_CCD on

L200 - Test Points

Number	Description	Value
TP1	GND (logic)	0V
TP2	+24V	+24V
TP5	+5.0VD1	
TP6	GND (logic)	0V
TP7	+3.0V_CCD	
TP8	+5.0V_CCD	
TP9	+3.3V_CCD	
TP10	+8V_RAW	
TP11	+5.0VD2	
TP12	+15V	
TP13	FAN VOLTAGE	>20V
TP14	+3.3V_CCD	
TP16	CCDENA	5V on, 0V off
TP17	-9.4V_CCD	
TP18	U_IN	Between 2.2V and 2.8V

L200 - Connectors

J201

Pin	Signal	Description
1	+5.0VD1	Supply voltage (L400 CPU)
2	GND	Ground (logic)

J202

Pin	Signal	Description
1-4,15,16	GND	GND (logic)
5,6	+3.3V_CCD	Continuous supply voltage (CCD)
7,8	+15V_CCD	Supply voltage (CCD)
9,10	+3.0V_CCD	Supply voltage (CCD)
11,12	-9V_CCD	Supply voltage (CCD)
13,14	+5.0V_CCD	Supply voltage (CCD)

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J204

Pin	Signal	Description
1	+5.0VD2	Supply voltage (logic)
2,4	GND	Ground (logic)
3	+3.3V_CCD	Continuous supply voltage (CCD)
5	REGTEMP	Regulator temperature
6	CCDENA	CCD sensor supply voltage, +5V when active
7	U_IN	Line voltage peak level detection
8	FANPWM	Temperature controlled fan

J205

Pin	Signal	Description
1,4	18 VAC	Transformer secondary voltage
2,5	9 VAC	Transformer secondary voltage
3,6	8 VAC	Transformer secondary voltage

J206

Pin	Signal	Description
1,2	+24V_STEP	Supply voltage (stepper motors)
3,4	GND	Ground (logic)

J207

Pin	Signal	Description
1	+24V_STEP	Supply voltage FAN
2	GND	Ground

J208

Not used

J209

Pin	Signal	Description
1,2	+24V	Supply voltage display adapter
3,4	GND	Ground

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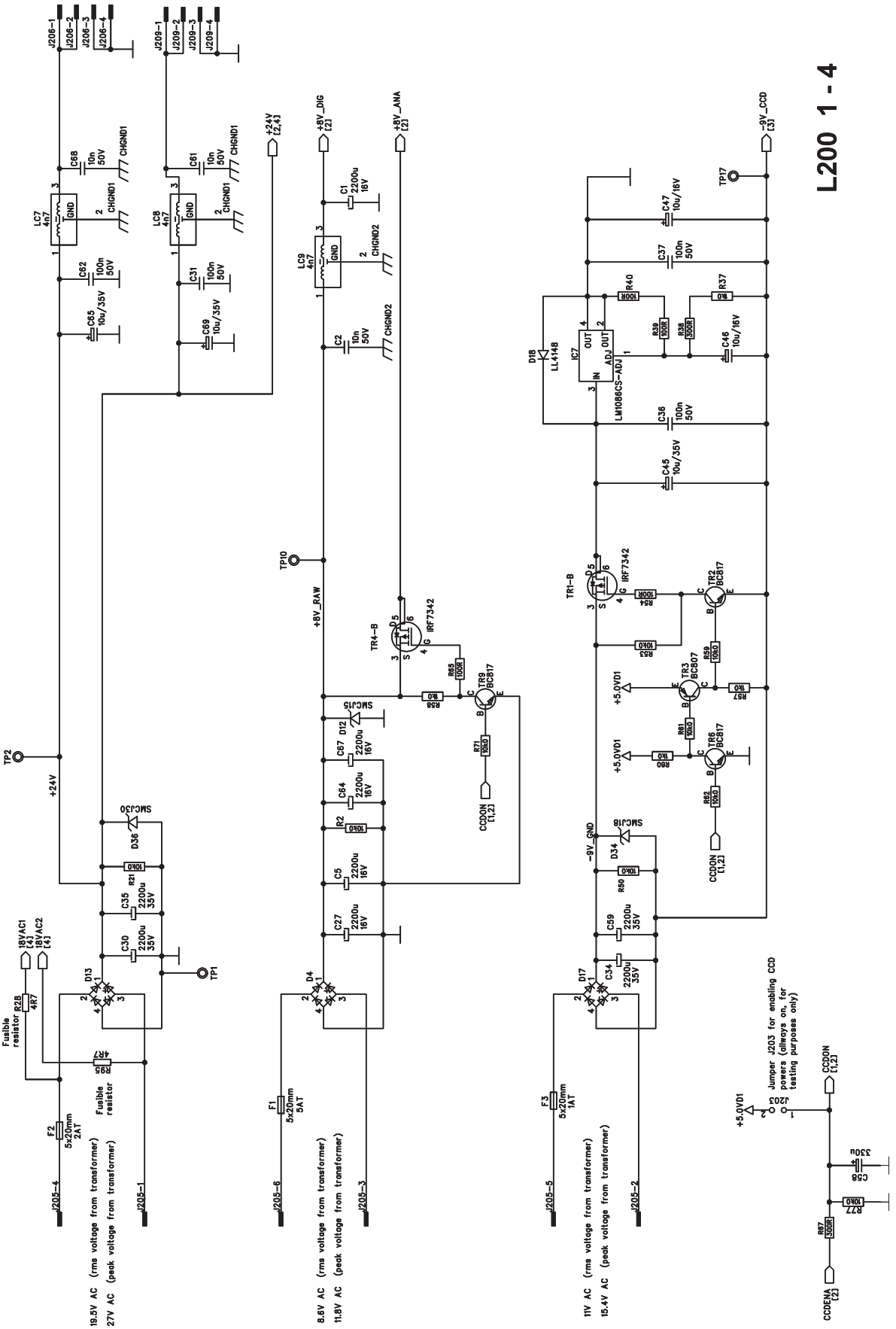

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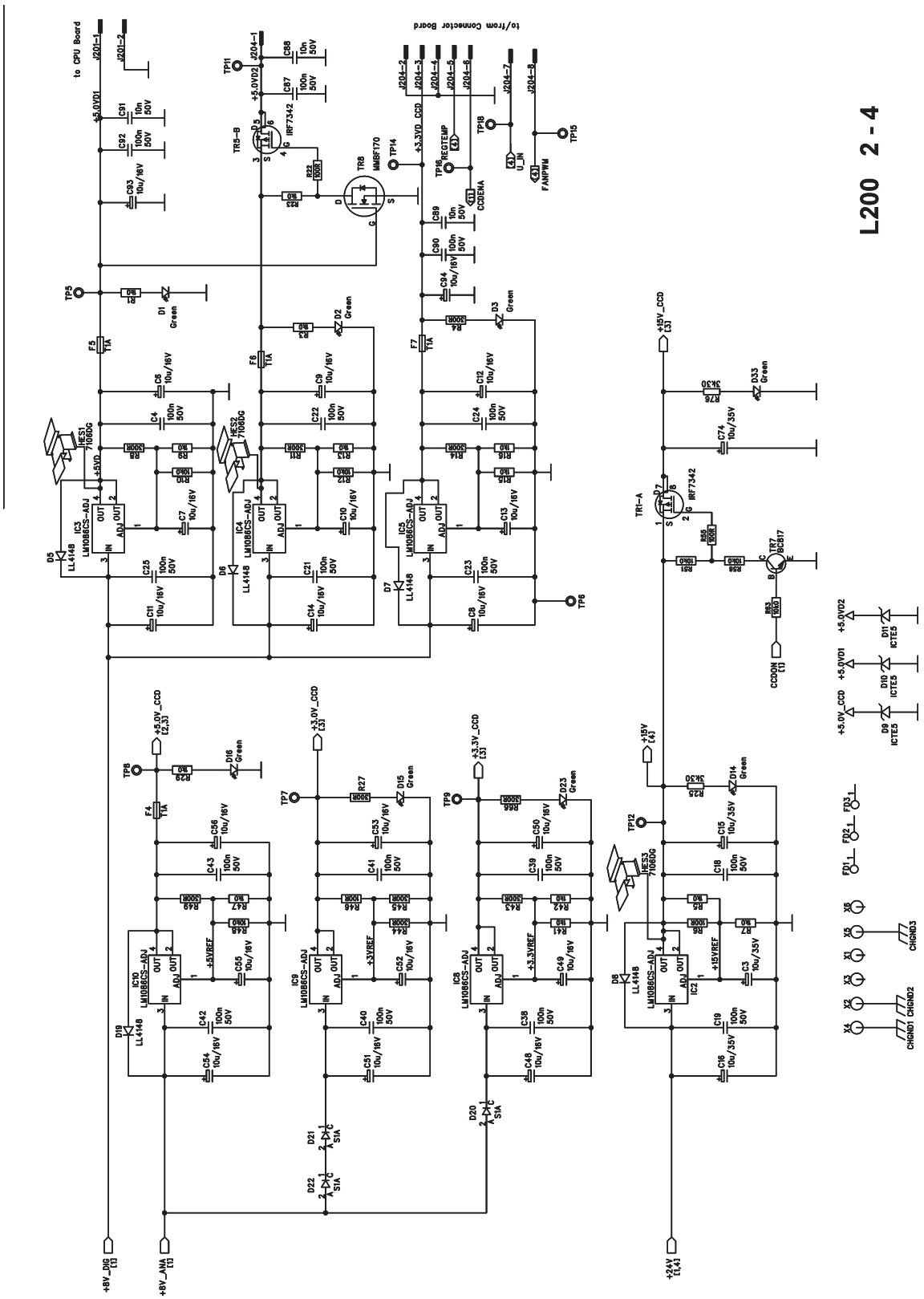

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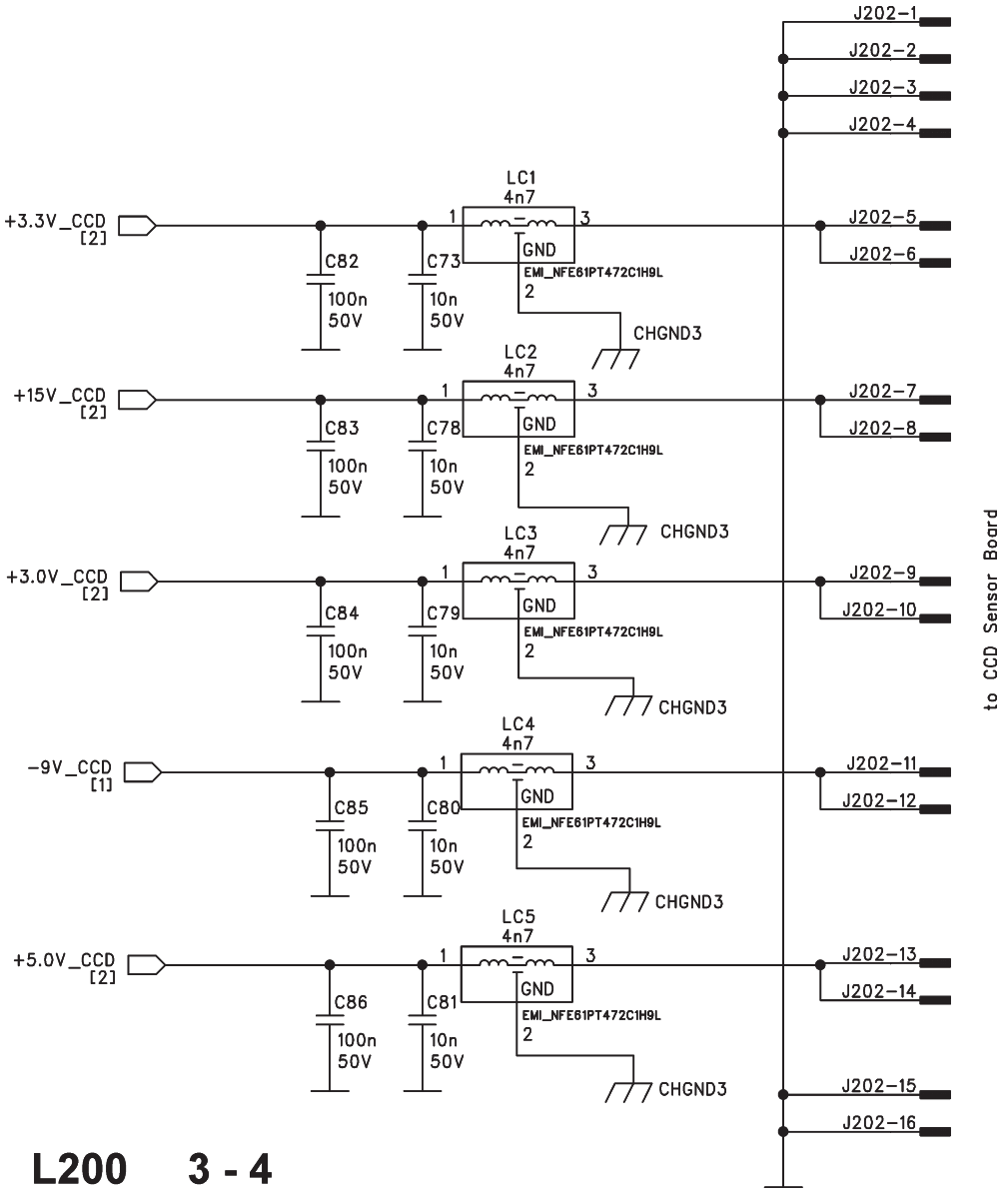

L200 3 - 4

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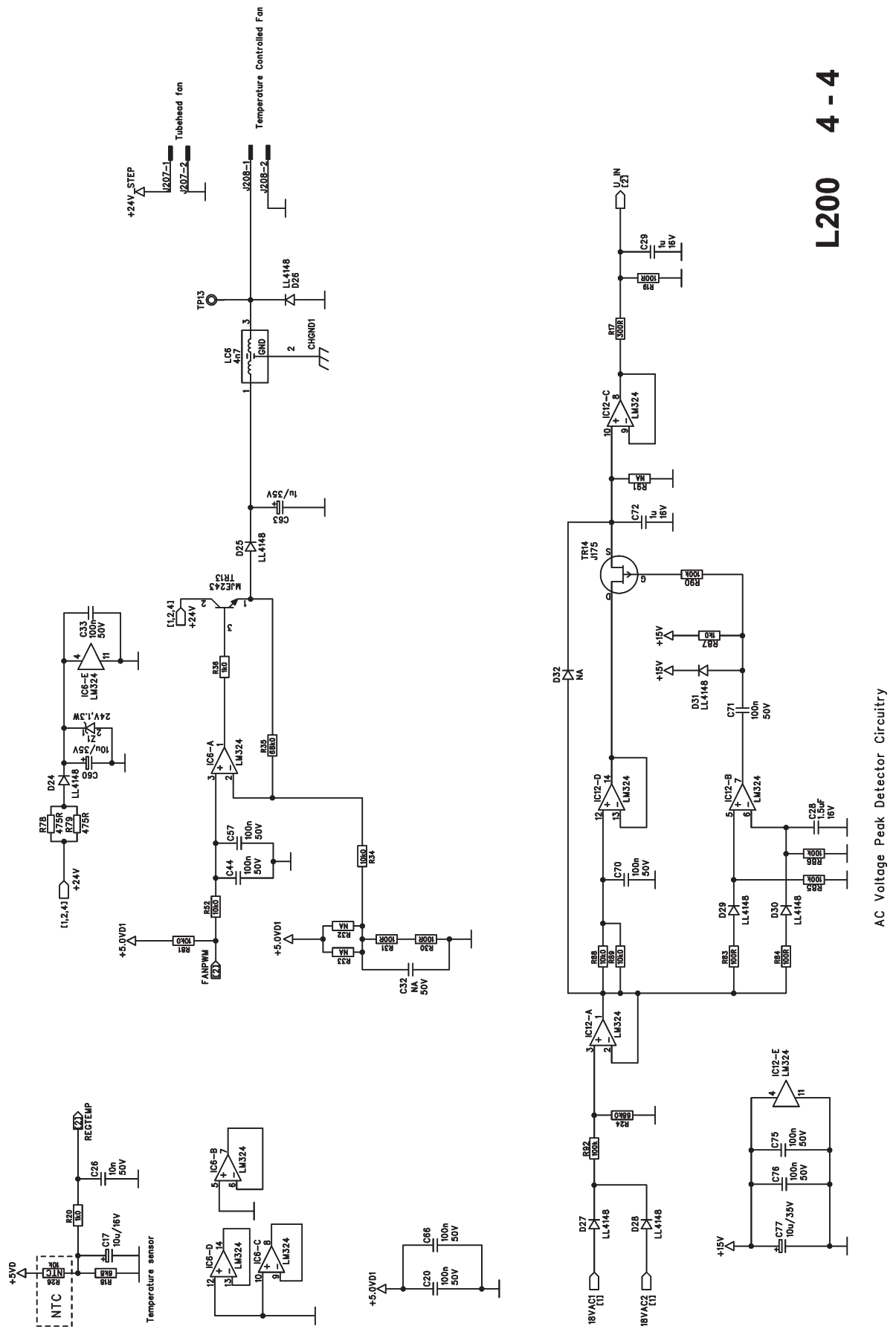

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
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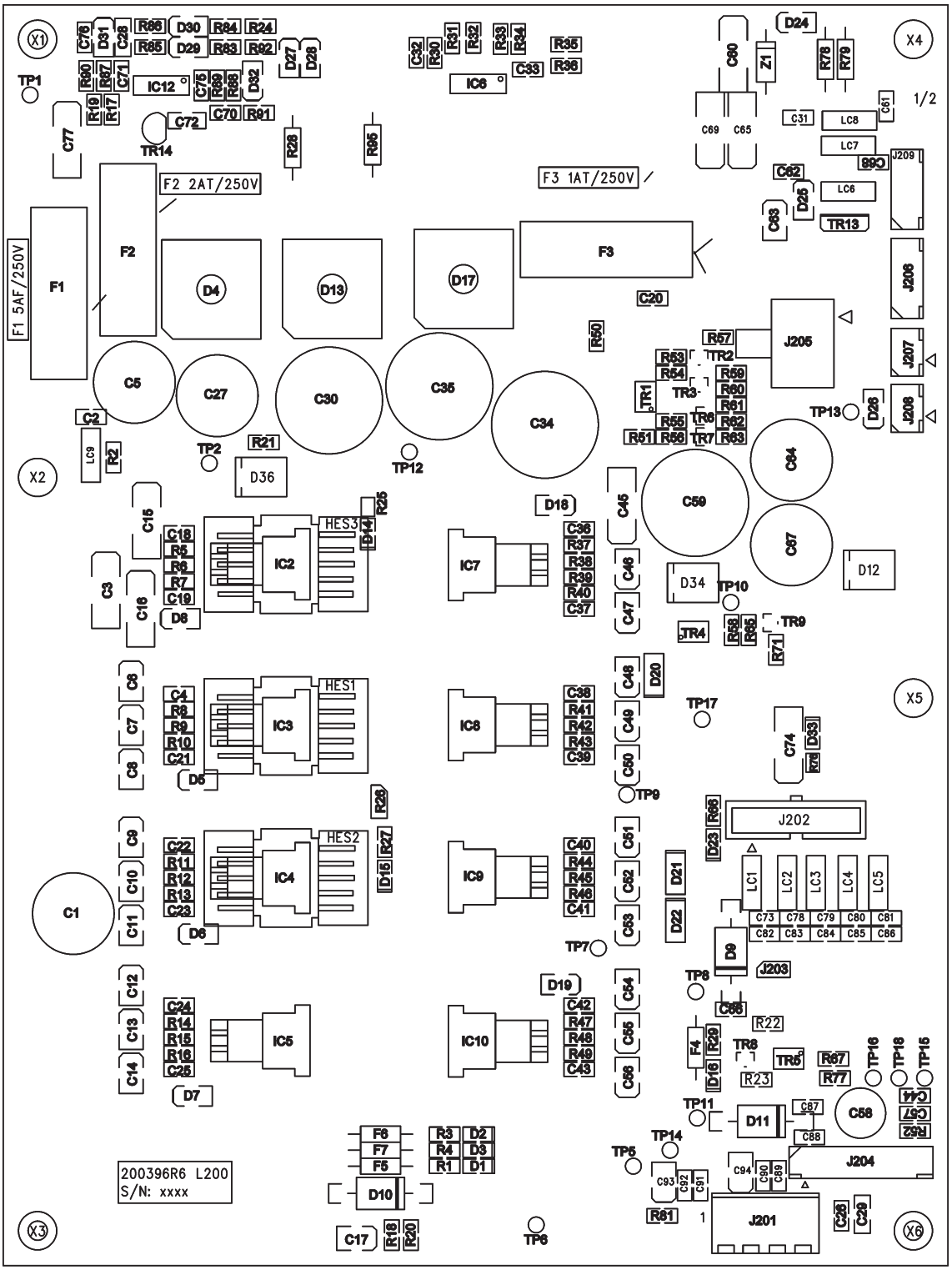

L200

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Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
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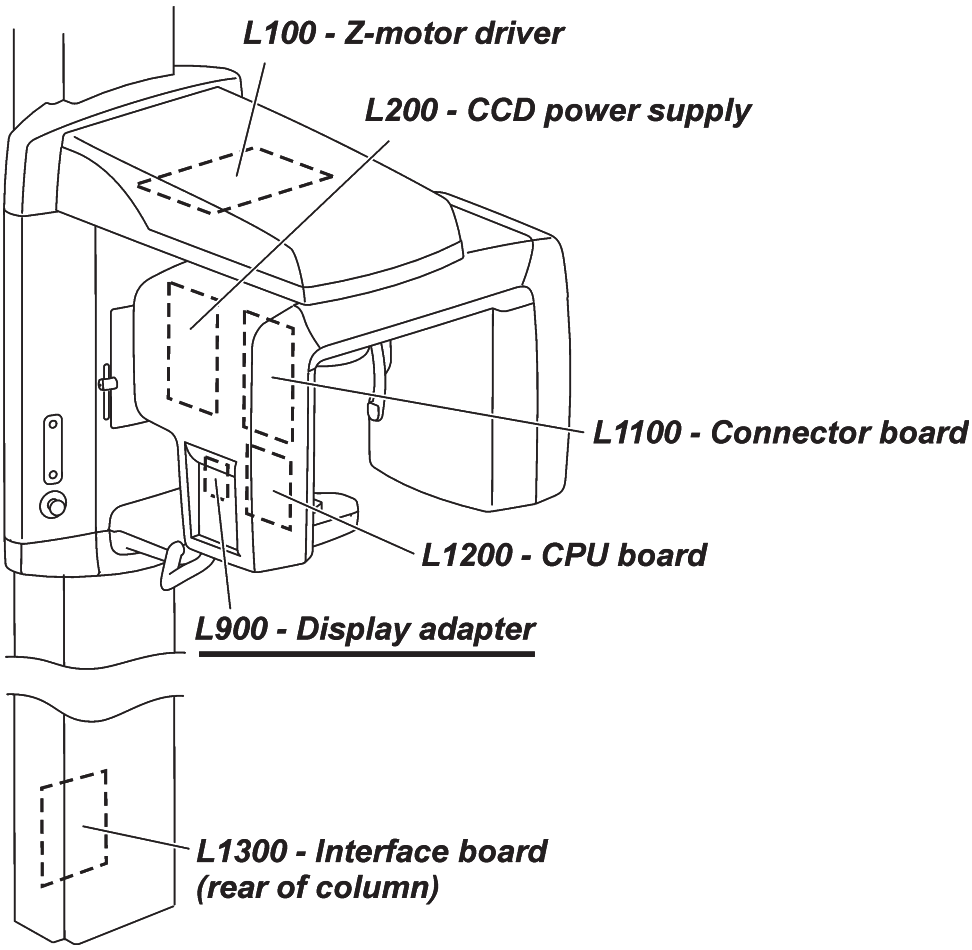
3.3 L900, Display adapter

L900 - Location

In the rotating unit on the the CCD sensor side.
To access remove sensor external cover.
CAUTION:
It is attached to the frame of the sensor external cover (see section 7.1).


L100 - Z-motor driver
L200 - CCD power supply
L1100 - Connector board
L1200 - CPU board
L900 - Display adapter
L1300 - Interface board
(rear of column)

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L900 - Field replaceable parts

None

L900 - Description

L900 is a display adapter/interface board that controls the display (touch screen interface). L900 reads touch screen data and sends it to L1200 CPU board via the SPI interface. L1200 CPU board drives the display data throught the L900 board.
L900 board produces supply voltages +3.3V for the display and +20V for the display backlight
NOTE:
L900 rev 1 - 5 is only compatible with the OPTREX display. If the OPTREX display is replaced with the SHARP dispaly, L900 rev 1-5 MUST be replaced with L900 rev 6 and later.

L900 rev 6 and later is compatible with SHARP and OPTREX displays. Note that the switch setting are different.

L900 - Indicator LEDs

LED	Colour	Indicates
H1	green	3.3V OK
H2	green	20V OK

L900 - Connectors

J901

LCD data.

J902A and J902B, rev 1 - 5 OPTREX
J902C, rev 6 and later SHARP

Touch screen interfaces:

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J903

Pin	Signal	Description
1,2	+24V	Supply voltage display adapter
3,4	GND	Ground

J904

LCD-display interface.

J905

Display backlight. OPTREX LCD Panel

J1

Display backlight. SHARP LCD Panel

SW1 R6 and later

SW1	SW2	
ON	ON	OPTREX T-55265GD057J-LW-ACN
OFF	ON	SHARP LQ057Q3DG01

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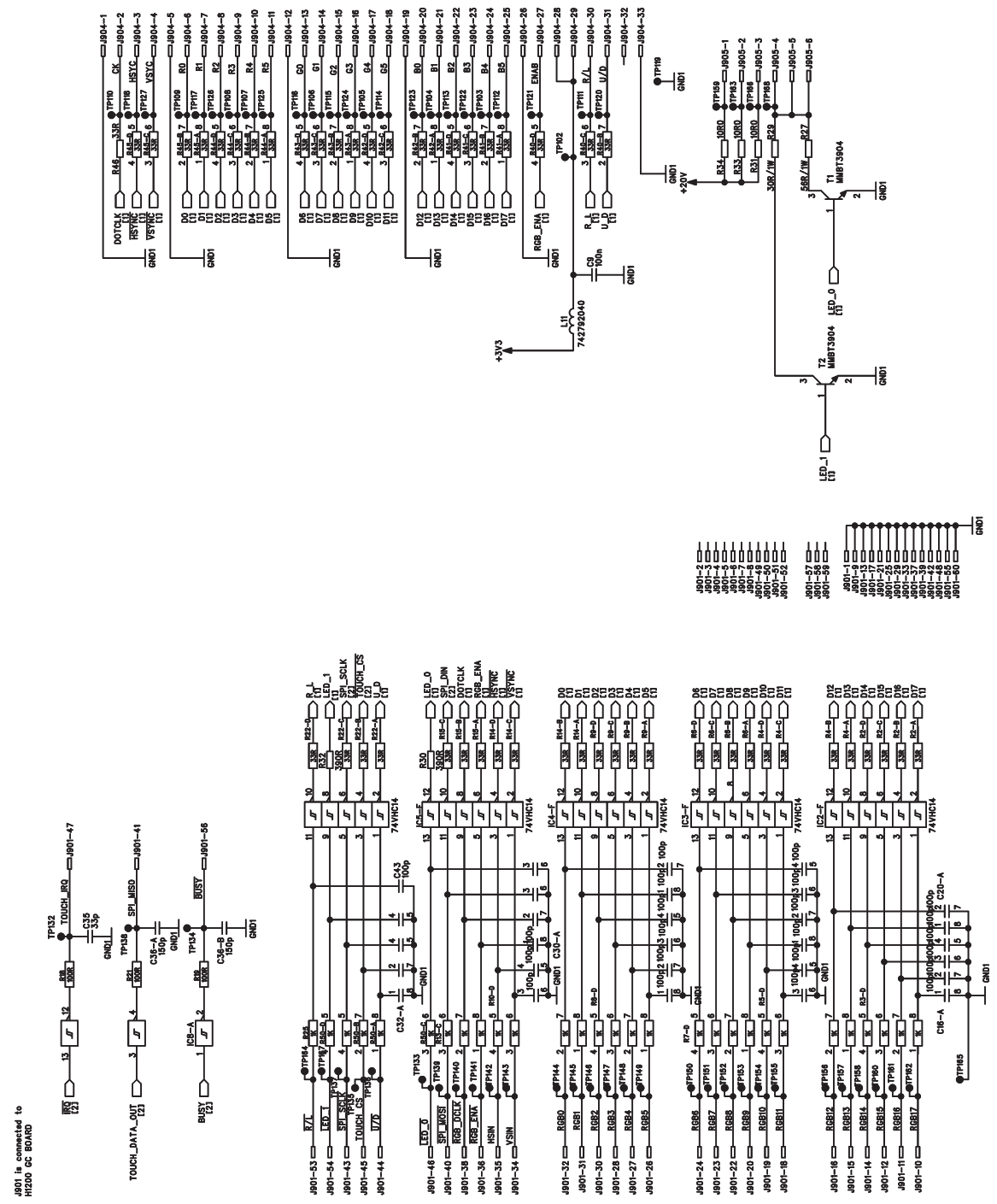

L900 1 - 3

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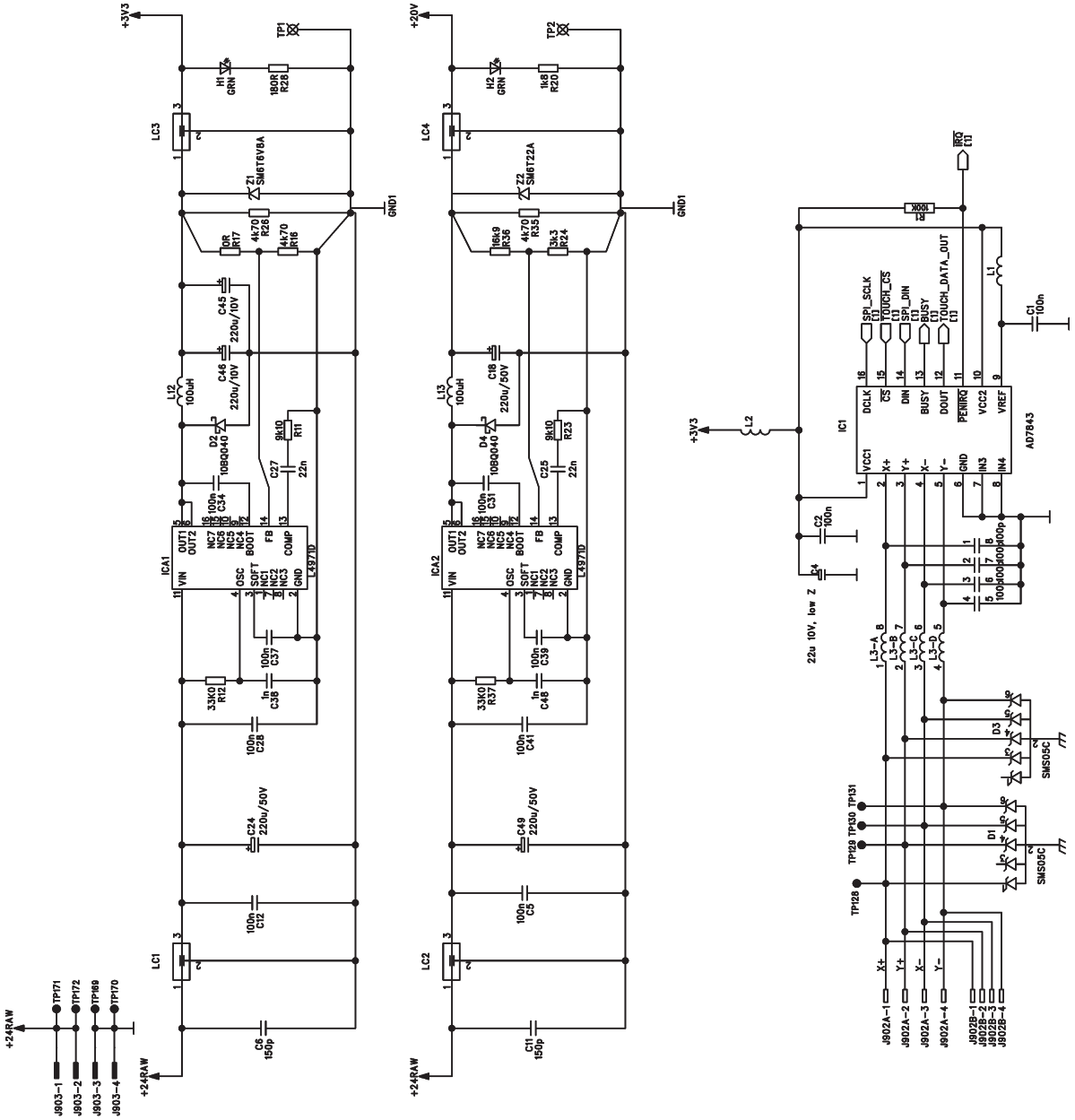

L900 1 - 3

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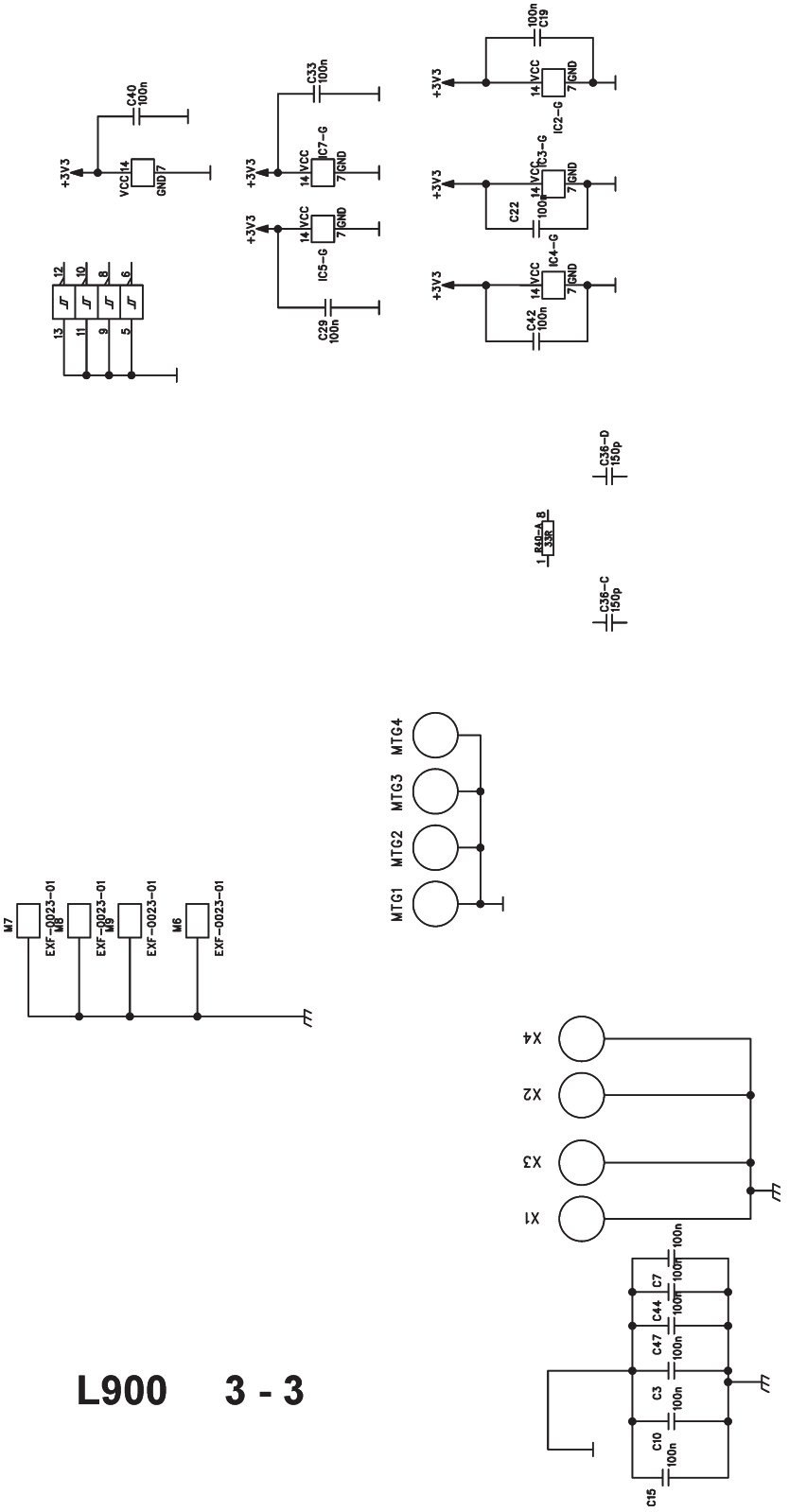

L900 3 - 3

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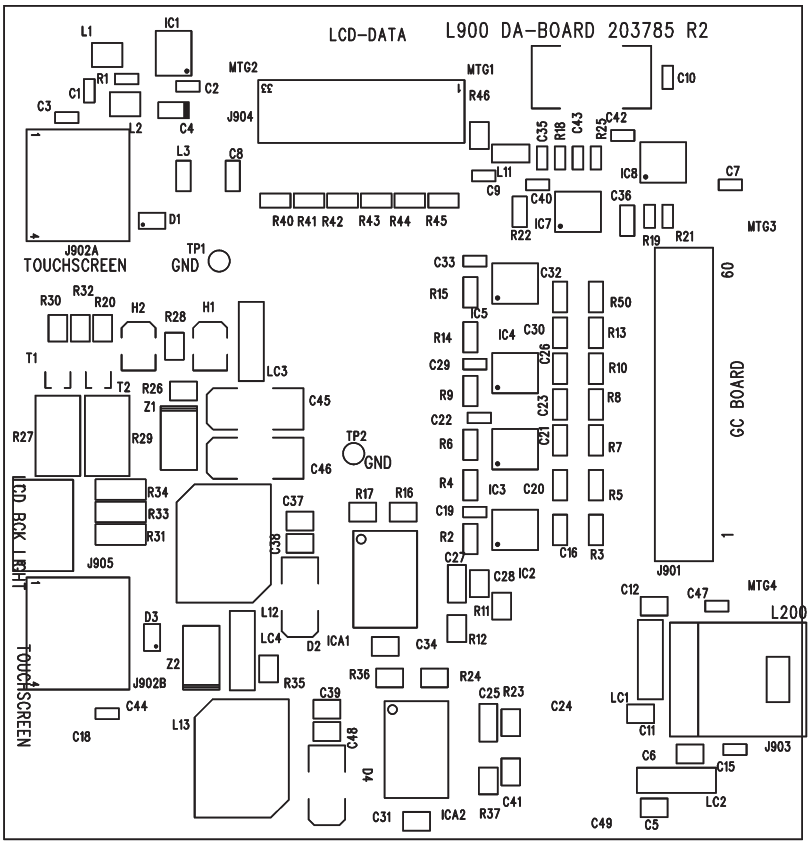
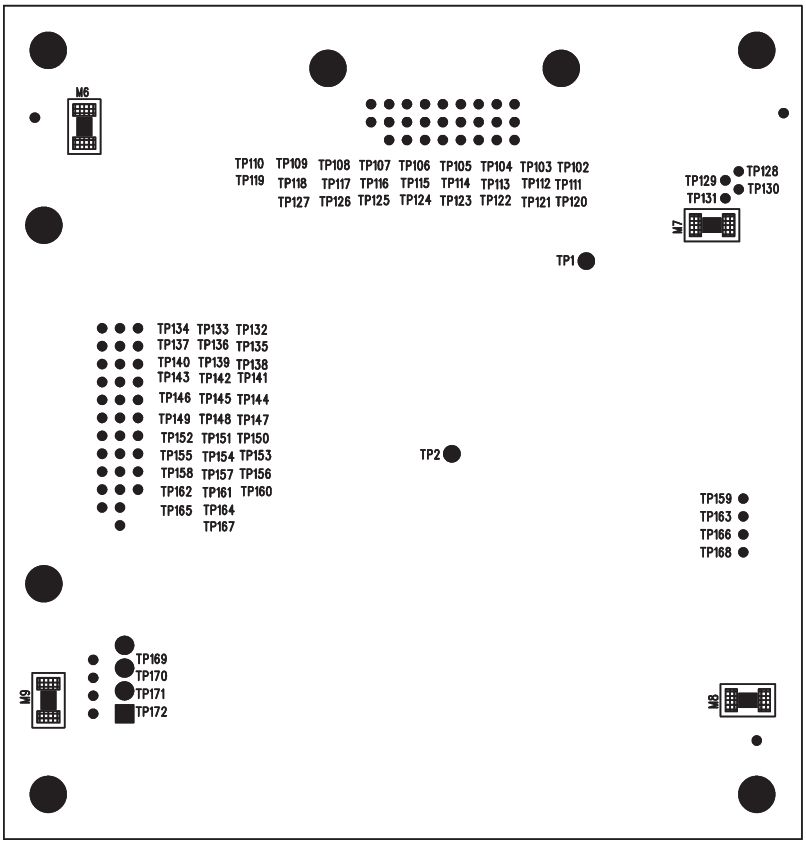


L900



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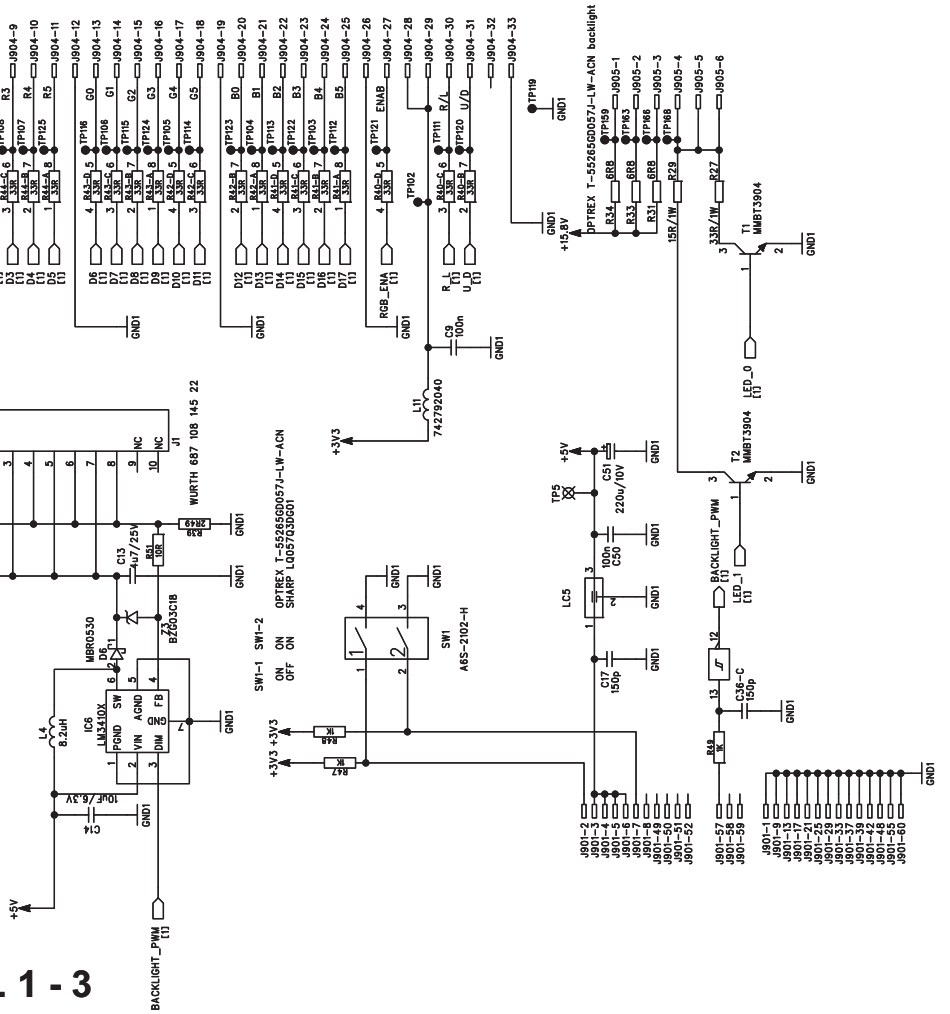
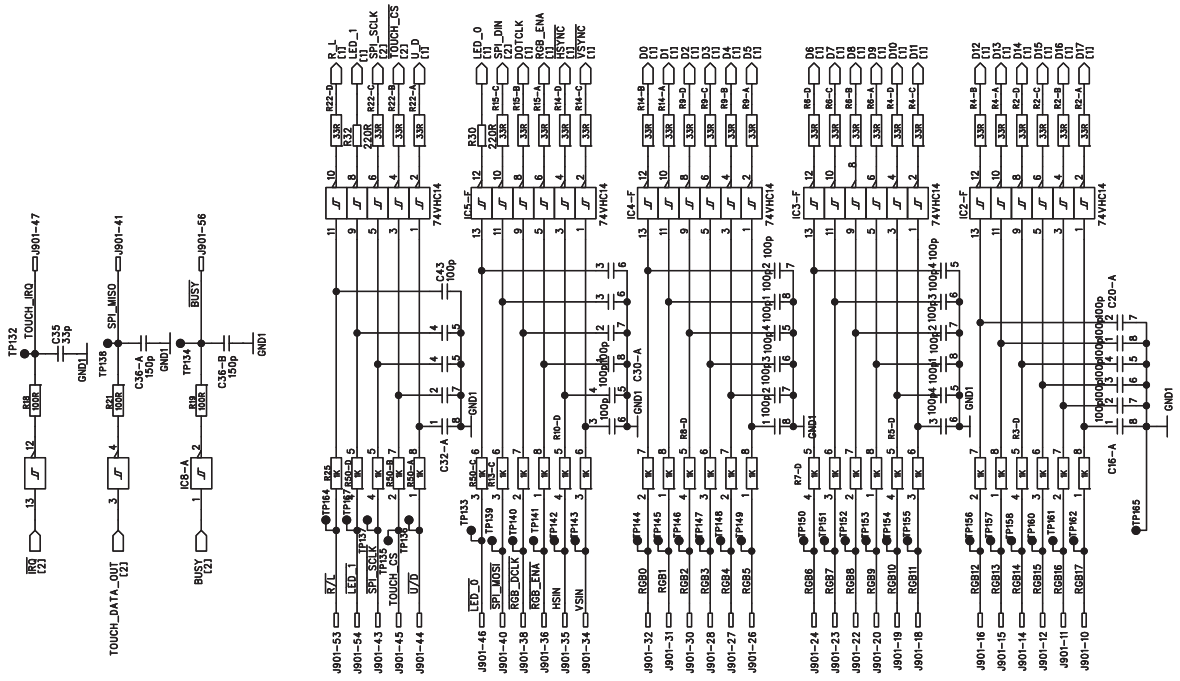


L900 Rev. 6. 1 - 3



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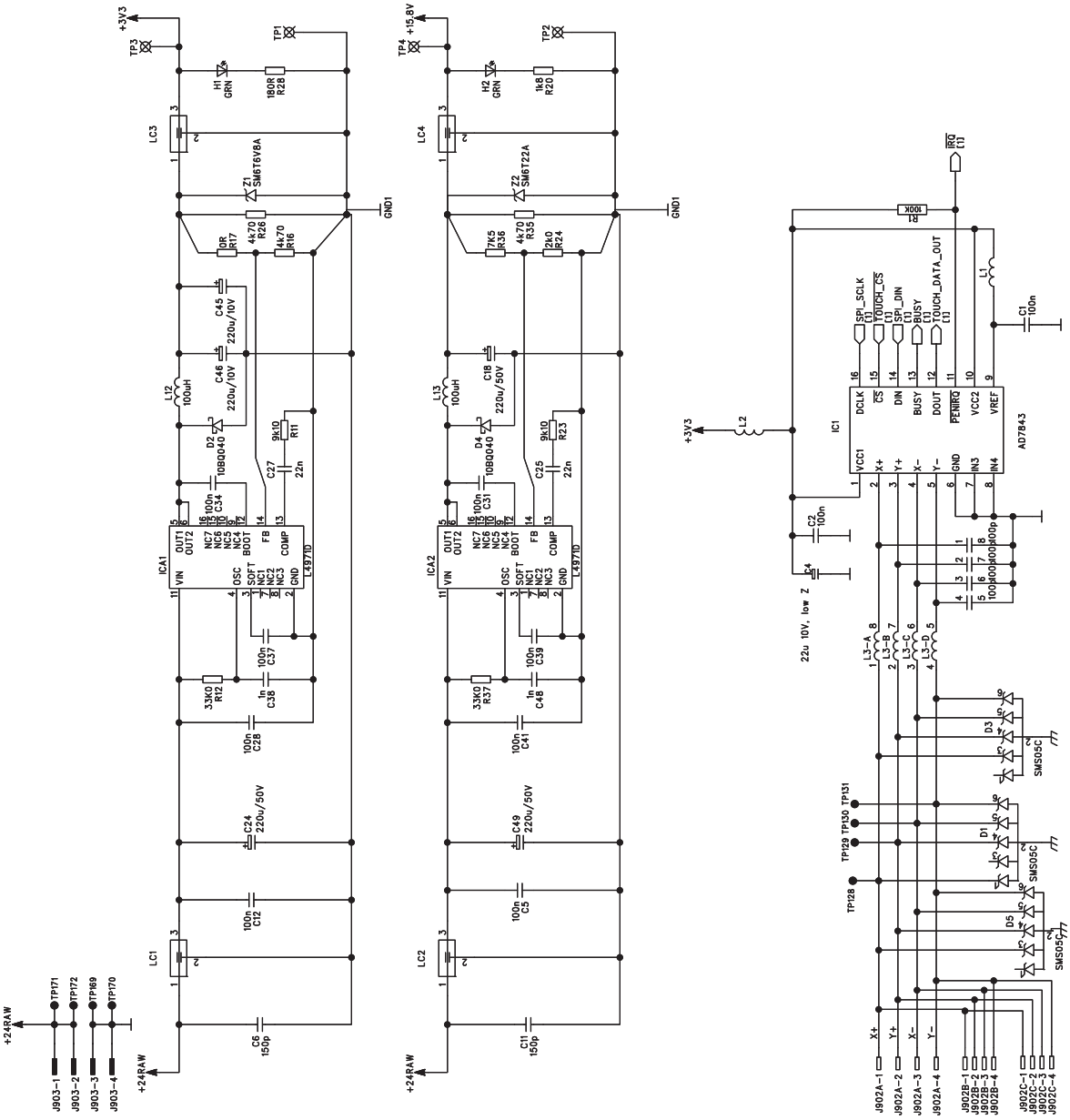

L900 Rev. 6. 2 - 3

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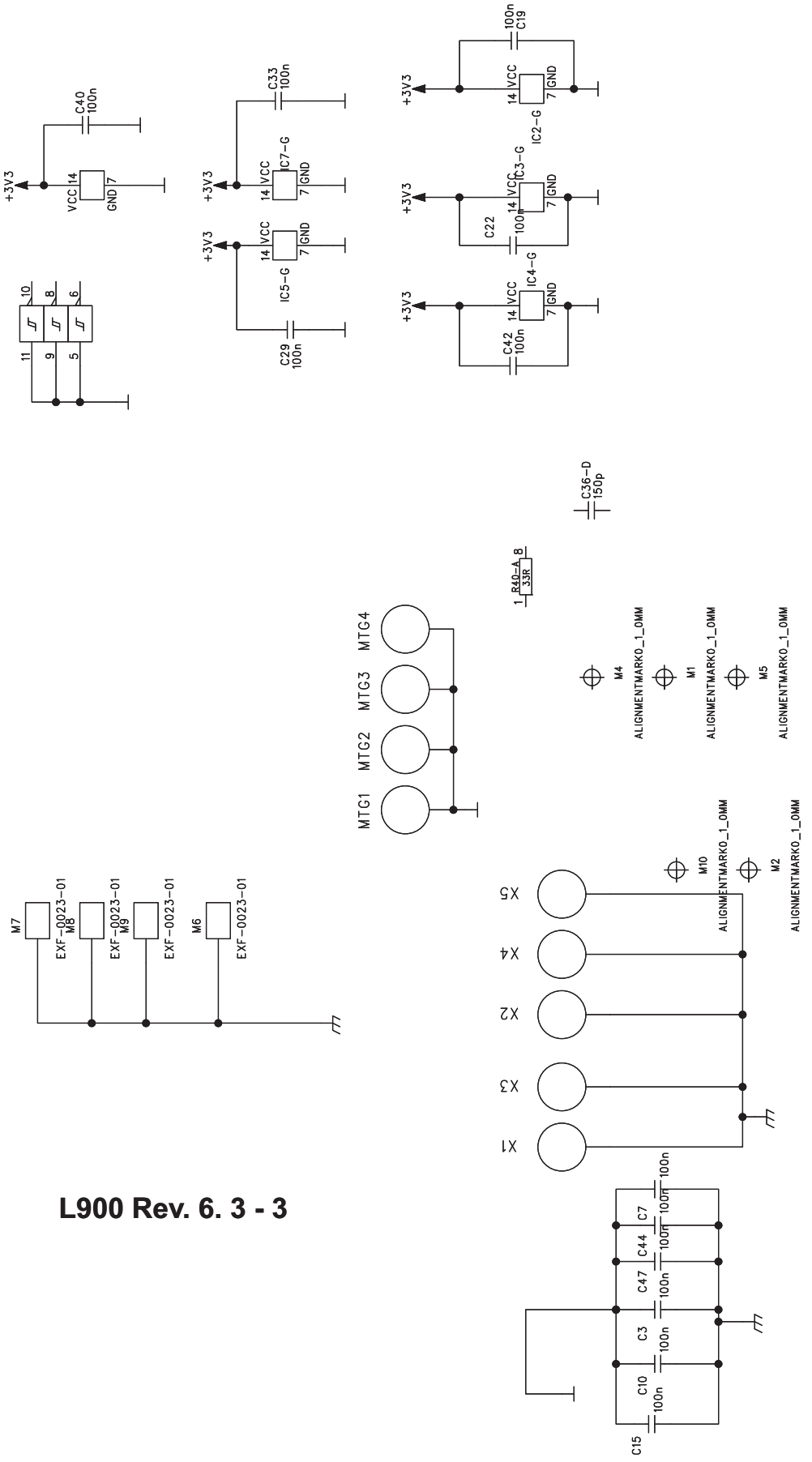

L900 Rev. 6. 3 - 3

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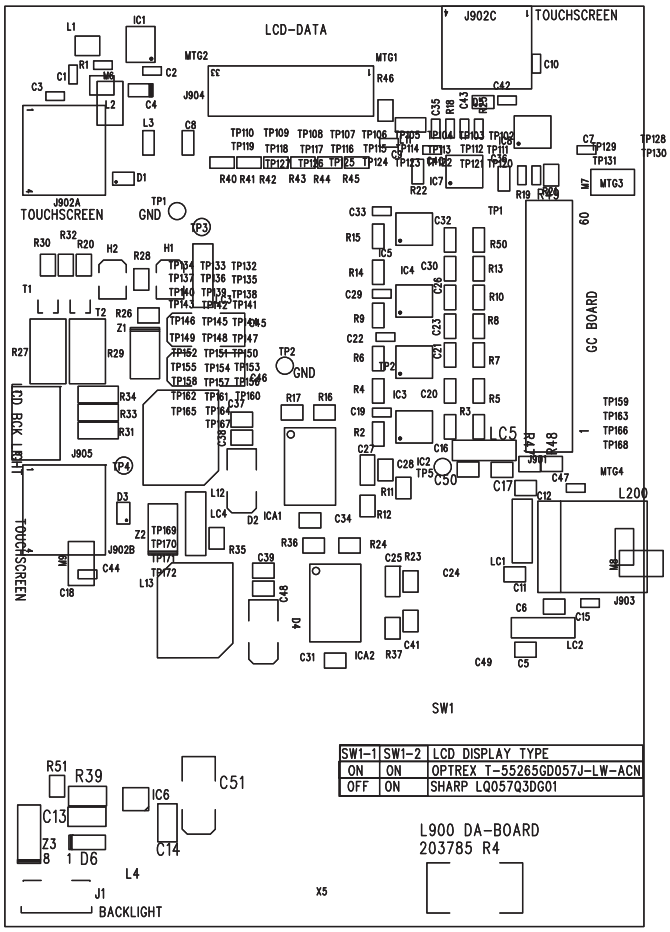

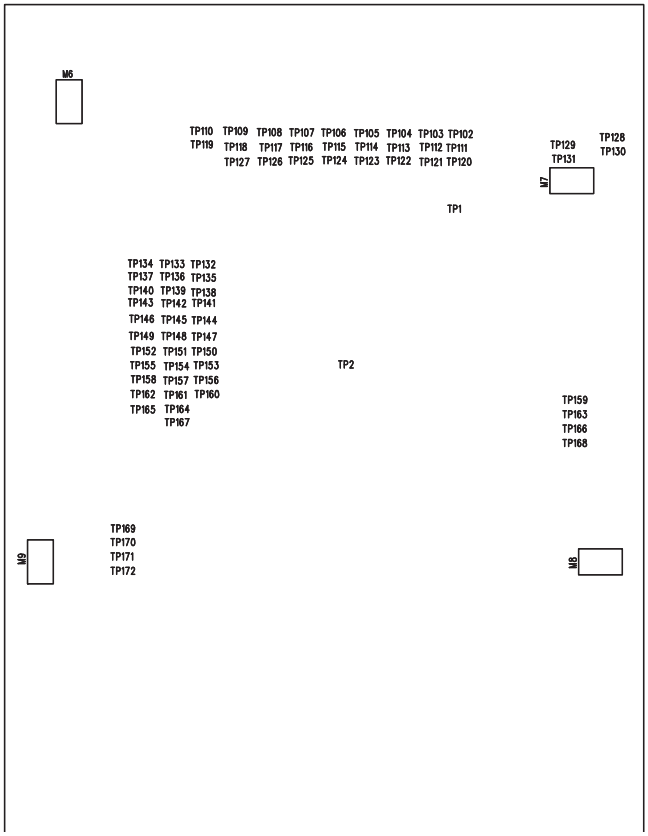

L900 Rev. 6

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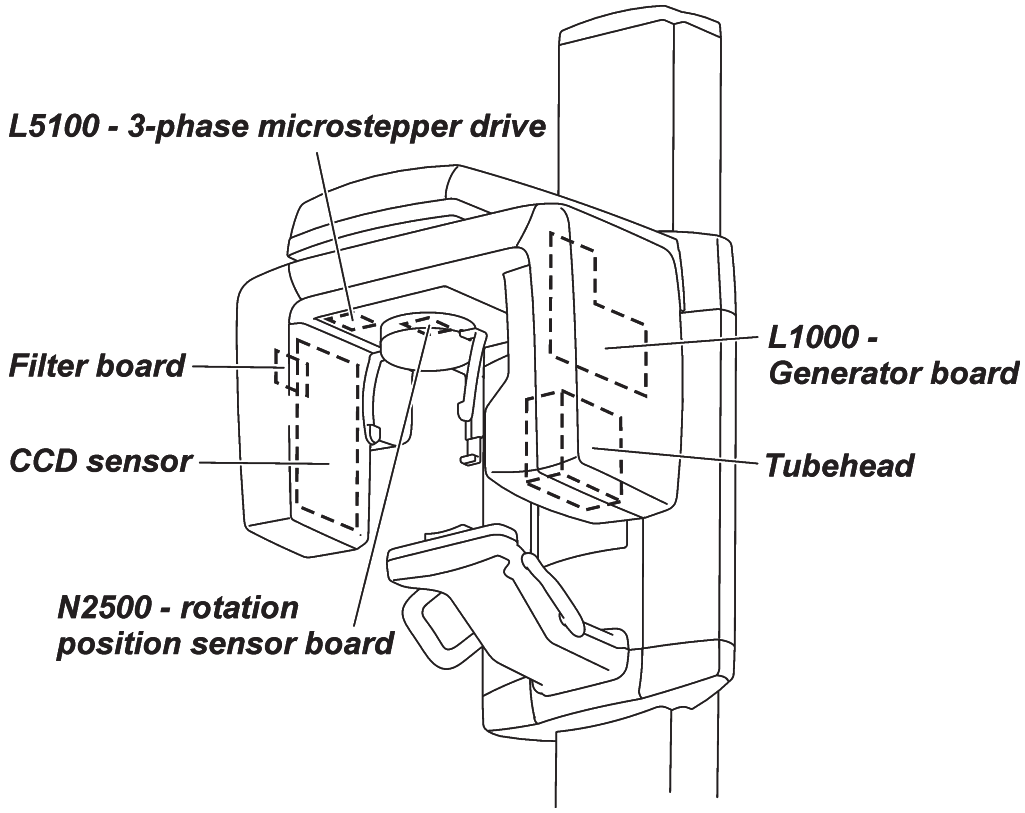
3.4 L1000, Generator Board

DANGER: HIGH VOLTAGE

WARNING:
Do not touch the Generator Board until the capacitors have discharged. After switching the unit off wait 10 minutes for the capacitors to discharge. When lamp LA1 goes out the capacitors are discharged.

L1000 - Location

In rotating unit on the the tubehead side. To access remove the tubehead external cover (see section 7.1).



L1000 - Field replaceable parts

Fuse FH1,
1amp, 230VAC

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L1000 - Description

The Generator board receives kV and mA reference signals from L1200 as digital values. Based on the kV-reference value, the Generator board generates the corresponding high voltage between the cathode and anode of the x-ray tube. Based on milliampere reference value, the generator board generates preheat current (to warm up the filament before x-rays are switched on) and filament current (during exposure). The Generator board receives kV and mA feedback signals from the tubehead that are used to monitor and adjust the generated values. The Generator board produces its own supply voltages.

L1000 - Indicator lights

LED	Colour	Indicates
LA1	Orange	+310V (capacitors charged)
H1	Green	+5V
H2	Green	+15V
H3	Yellow	Exposure
H4	Red	Tube fail
H5	Yellow	Preheat
H6	Green	+15V

Gen. brd - Test Points

Number	Signal	Value
TP1		+34V
TP2		+5V
TP3	GND	0V
TP4		+15V
TP5	-	NOT USED
TP6	-	NOT USED
TP7	HVGND	0V
TP8		+24V
TP9	VDD	+15V
TP10	-	NOT USED
TP11	mAref	Calibrated by the CPU
TP12	kVref	1V = 22kV; thus 3V=66kV and 3.5V=77kV
TP13	-	NOT USED
TP14	kVfb	1V = 22kV; thus 3V=66kV and 3.5V=77kV
TP15	EXPENA	on to enable off to disable
TP16	-	NOT USED

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TP17	GND	0V
TP18	mAfb	2V @ 10mA
TP19	Tubeheat	
TP20	-	NOT USED
TP21	-	NOT USED
TP22	HVGND	Mains voltage side, ground
TP23	HV310	310V

L1000 - Connectors

X43

Pin	Signal	Description
1	27VAC (+)	Secondary transformer winding for 27VAC
2	27VAC (+)	Secondary transformer winding for 27VAC
3	27VAC (-)	Secondary transformer winding for 27VAC
4	27VAC (-)	Secondary transformer winding for 27VAC

X44

Pin	Signal	Description
1	19VAC (+)	Secondary transformer winding for 19VAC
2	19VAC (-)	Secondary transformer winding for 19VAC

X45 (230VAC)

Pin	Signal	Description
1	-	NOT USED
2	N	Neutral
3	-	NOT USED
4	-	NOT USED
5	L	Line (230VAC)
6	-	NOT USED

X46 (115VAC)

Not used

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X47

Pin	Signal	Description
1	N	Neutral (from mains switch)
2	-	NOT USED
3	L	Line (from mains switch)
4	-	NOT USED

X48

Pin	Signal	Description
1	HV2	High voltage transformer primary winding
2	HV1	High voltage transformer primary winding

X49

Pin	Signal	Description
1, 2	TUBEFAIL*	X-ray tube failure
3, 4	EXPENA*	Exposure enabled
5, 6	KVPWM	kV reference (a PWM-signal)
7, 8	GND	Ground
9, 10	KVFB	kV feedback
11, 12	GND	Ground
13, 14	PREH_2*	Preheat
15, 16	MAPWM	mA reference (a PWM-signal)
17, 18	MAFB	mA feedback
19, 20	TUBEHEAT	X-ray tube's temperature

X50

Pin	Signal	Description
1	KVFB	kV-feedback
2	GND	Ground
3	HEATCURRENT	Tube temperature
4	MAFB	mA feedback
5 - 8	GND	Ground
9	FILAMENT VOLTAGE (+)	
10	FILAMENT VOLTAGE (-)	

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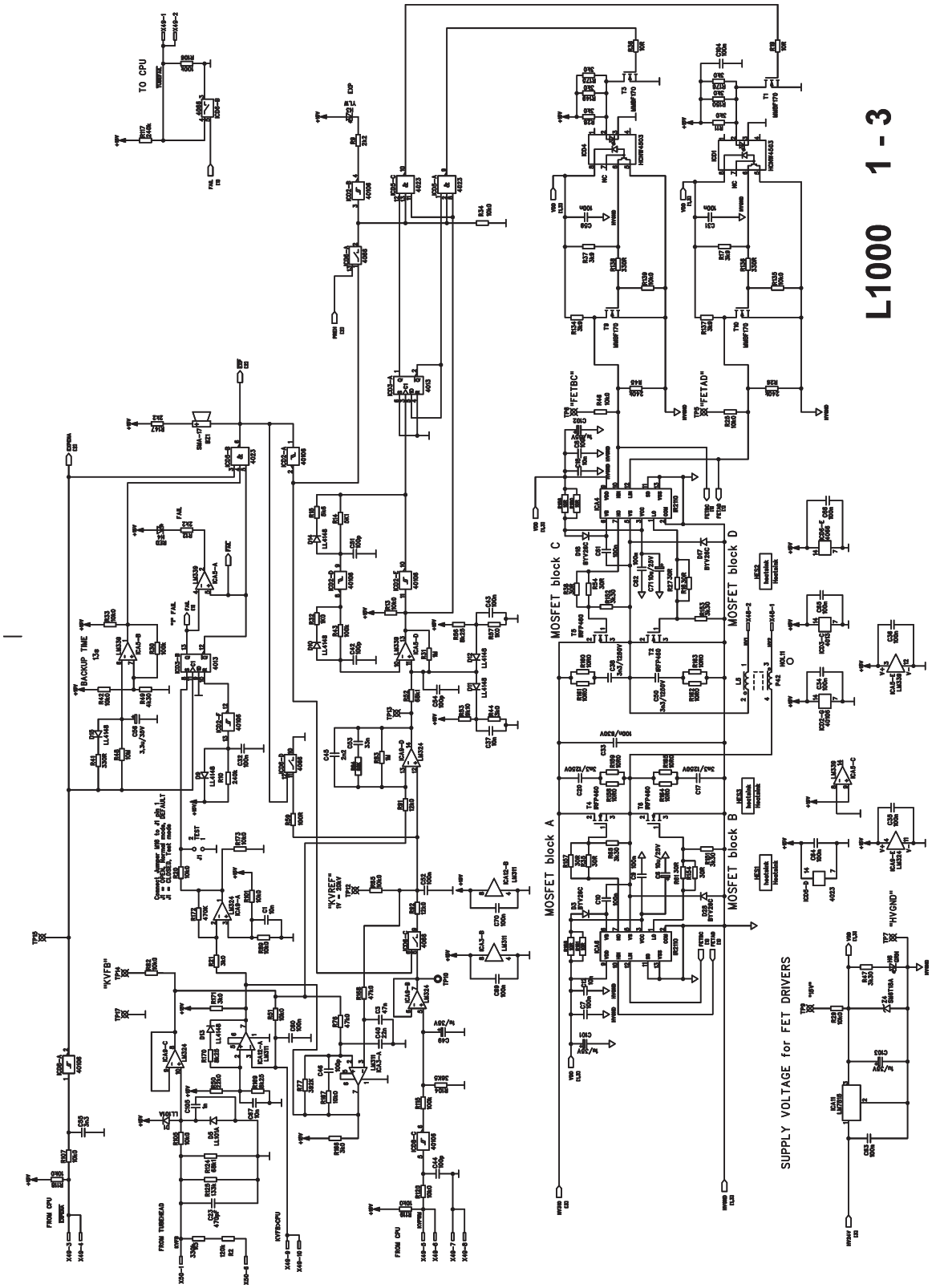

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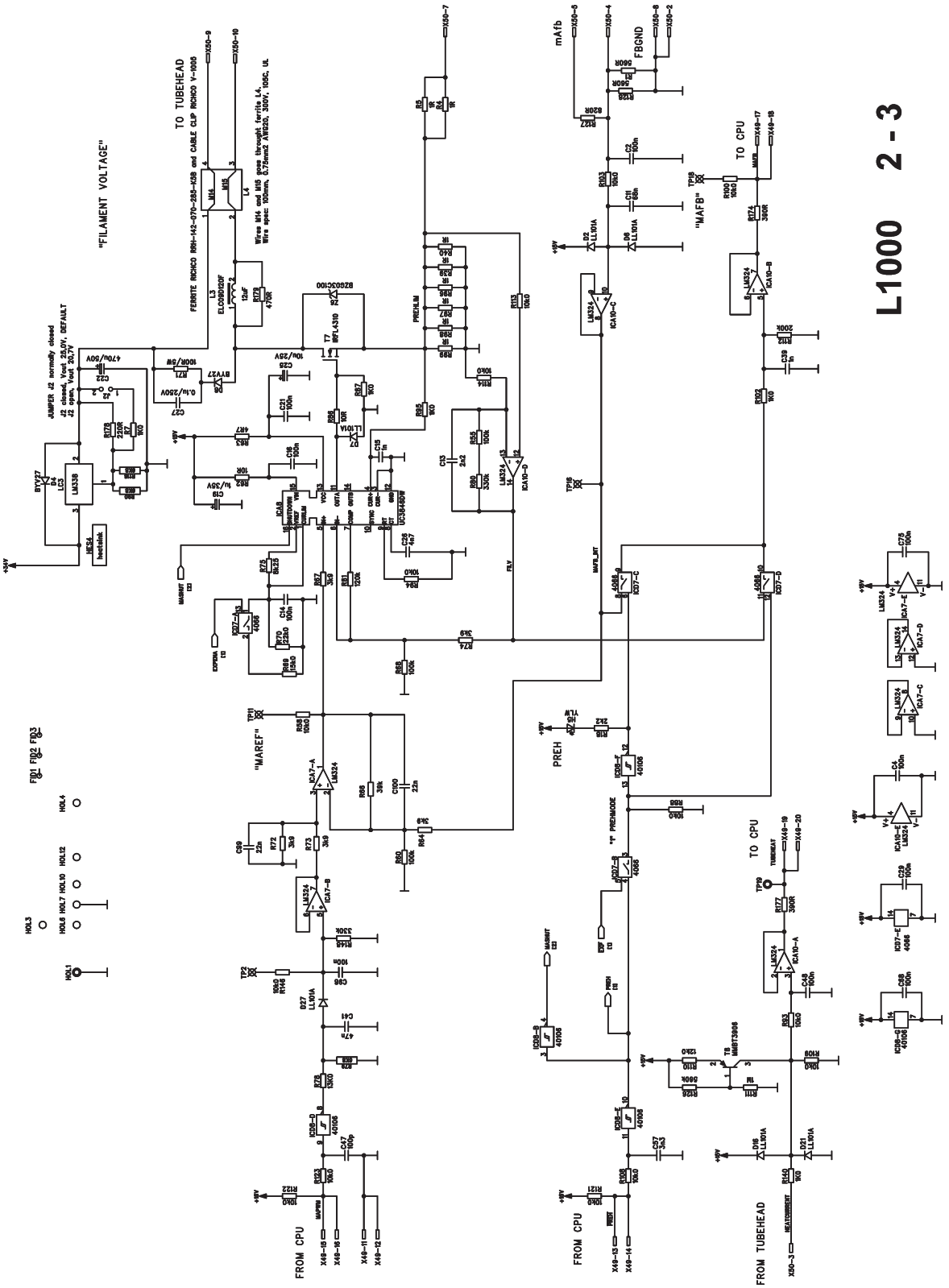

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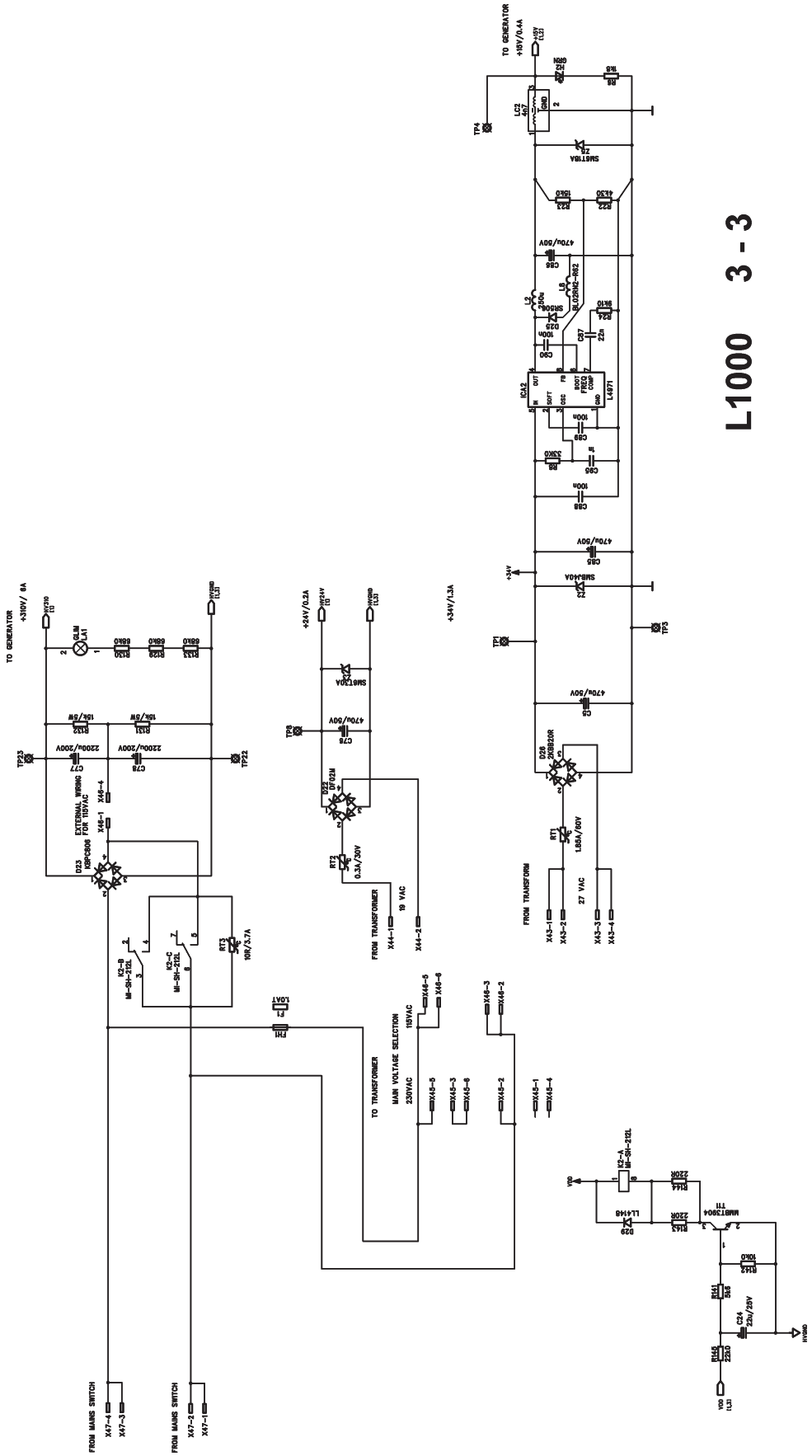

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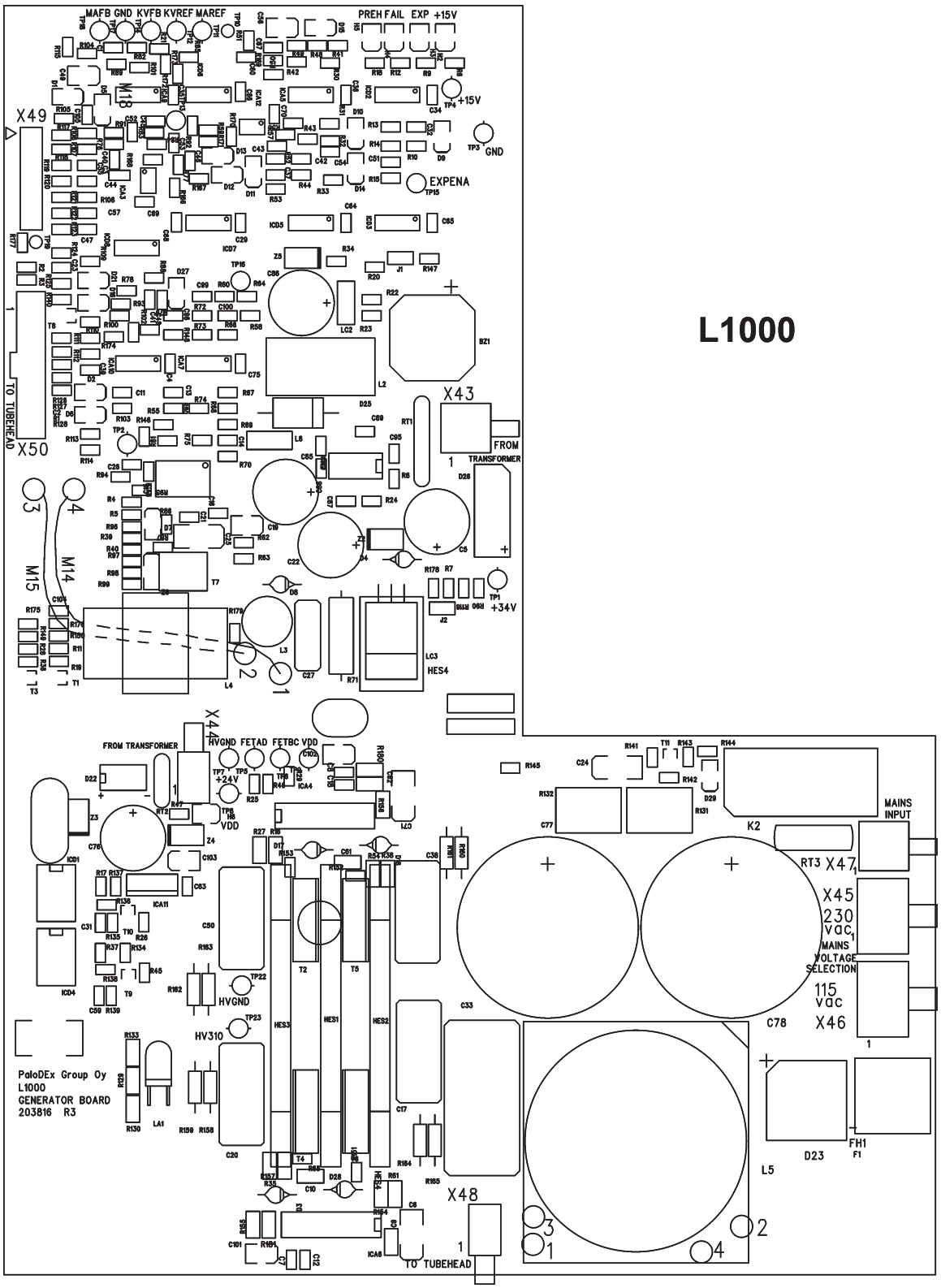

L1000

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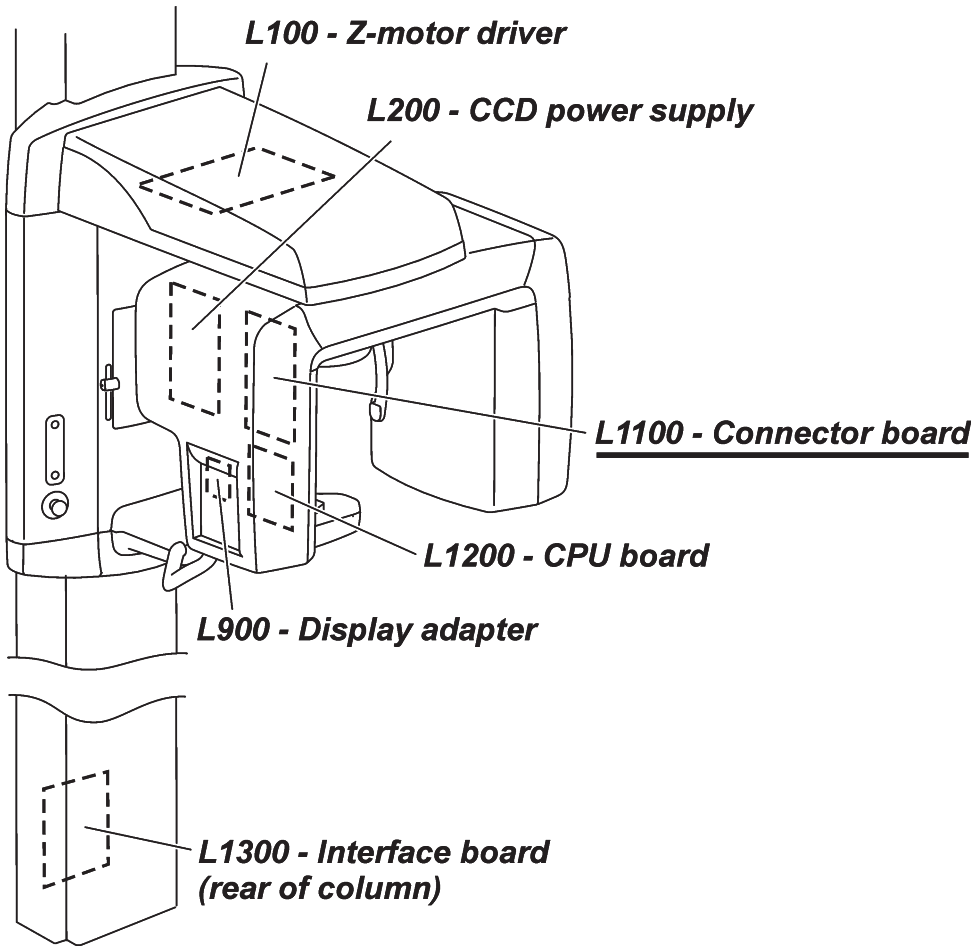
3.5 L1100 Connector Board

L1100 - Location

In the rotating unit on the the CCD sensor side.
To access remove sensor external cover.
CAUTION:
The touch screen is attached to the cover. Disconnect (see section 7.1).


L100 - Z-motor driver
L200 - CCD power supply
L1100 - Connector board
L1200 - CPU board
L900 - Display adapter
L1300 - Interface board
(rear of column)

L1100 - Field replaceable parts

None.

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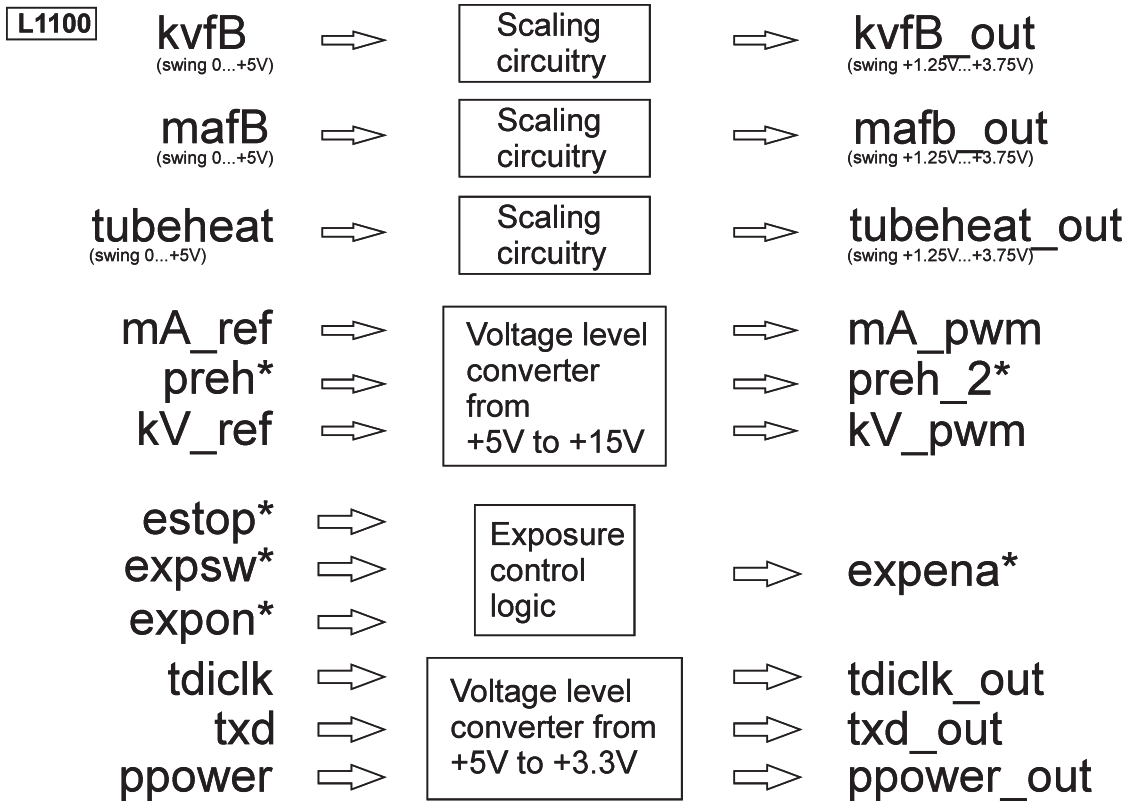
L1100 - Description

L1100 routes most of the signals to the other boards. L1100 receives signals from the tubehead (kVfb, mafb, and tubeheat) and scales the voltage swing (0…+5V) linearly to (1.25V…3.75 V) which is the input for the A/D converter on the CPU board. L1100 also includes external warning and ready light circuitry. The ESTOP signal enables stepper motor rotation and the exposure sequence.

L1100 - Block Diagram



L1100 - Test Points

Number	Description	Value
TP1	GND	0V
TP2	GND	0V

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L1100 - Connectors

J501

Pin	Signal	Description
1, 2	TUBEFAIL*	X-ray tube failure
3, 4	EXPENA*	Exposure enabled
5, 6	KVPWM	kV-reference
7, 8	GND	Ground
9, 10	KVFB	kV-feedback
11, 12	GND	Ground
13, 14	PREH_2*	Preheat
15, 16	MAPWM	mA-reference
17, 18	MAFB	mA-feedback
19, 20	TUBEHEAT	X-ray tube's temperature

J502

Pin	Signal	Description
1	HICUR*	High current selection
2	GND	GND (logic)
3	CLK*	Stepper motor clock
4	GND	GND (logic)
5	DIR*	Stepper motor direction
6	ENA*	Stepper motor enabled
7	+5.0VD2	Supply voltage
8	GND	GND (logic)

J503

Pin	Signal	Description
1	+5.0VD2	Supply voltage
2	+5.0VD2	Supply voltage
3	ESTOP*	Emergency stop
4	PL_ENA	Position lights enabled
5	ZENA*	Z-motor movement enabled
6	KEY_STATUS_OK	NOT USED
7	RETURN2*	Return membrane switch (side control panel)
8	-	NOT USED
9	ZACT*	Z-movement activity
10	PLSW	Position light switch
11	EXPSW*	Exposure switch
12	GND	GND (logic)
13	RDYLT	Ready light
14	EXPLT	Exposure light
15	GND	Ground (logic)
16	GND	Ground (logic)

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J504

Pin	Signal	Description
1	+5.0VD2	Supply voltage
2	ROTSW1	Rotation position optoswitch #1
3	ROTSW2	Rotation position optoswitch #2
4	GND	Ground (logic)

J505

CAUTION:
When reconnecting this connector make sure that it is aligned correctly before switch the unit on. If the connector is misaligned the fuses on L200 may blow when the unit is switched on.

Pin	Signal	Description
1	GND	GND (logic)
2	GND	GND (logic)
3	D0	Data bit 0
4	D1	Data bit 1
5	D2	Data bit 2
6	D3	Data bit 3
7	D4	Data bit 4
8	D5	Data bit 5
9	-	NOT USED
10	-	NOT USED
11	HL	HIGH/LOW bit
12	VV	Valid video
13	-	NOT USED
14	IMAGE_OUT	Activates A/D conversion on CCD sensor board
15	TDICLK_OUT	Time Delay Integration
16	PPOWER_OUT	CCD sensor's supply voltages on CCD
17	GND	Ground
18,20,21,23	GND	Ground (logic)
19	DS	Data strobe
20	GND	Ground (logic)
21	GND	Ground (logic)
22	-	NOT USED
23	GND	Ground (logic)
24	TXD_OUT	Transmit data (serial connection)
25	RXD	Receive data (serial connection)
26	RESET_CCD*	Resets the CCD sensor
27	-	NOT USED
28	GND	Ground
29	GND	Ground
30	GND	Ground

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31	PAN_CAM_DET	Panorama sensor mode, value +5.0VD2
32	PAN_CAM_DET	Panorama sensor mode, value +5.0VD2
33	-	NOT USED
34	-	NOT USED
35	+3.3VD_CCD	Supply voltage (CCD sensor's uC-voltage)
36	+3.3VD_CCD	Supply voltage (CCD sensor's uC-voltage)
37	GND	Ground (logic)
38	GND	Ground (logic)
39	GND	Ground (logic)
40	GND	Ground (logic)

J506

Pin	Signal	Description
1	+5.0VD2	Supply voltage
2	GND	Ground (logic)
3	+3.3VD_CCD	Supply voltage (CCD sensor's continuous voltage)
4	GND	Ground (logic)
5	REGTEMP	Regulator temperature
6	CCDENA	CCD enabled
7	LINEOK	Line voltage
8	FANPWM	Fan's PWM control

J507

Not used

J508

Pin	Signal	Description
1	-	NOT USED
2	TUBEHEAT_OUT	Tube head temperature
3	-	NOT USED
4	-	NOT USED
5	-	NOT USED
6	LINEOK	Line voltage level
7	-	NOT USED
8	MAFB_OUT	mA feedback
9	-	NOT USED
10	KVFB_OUT	kV feedback
11	-	NOT USED
12	GND (logic)	Ground
13	GND (logic)	Ground
14	GND (logic)	Ground
15	GND (logic)	Ground

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16	GND (logic)	Ground
17	GND (logic)	Ground
18	GND (logic)	Ground
19	GND (logic)	Ground
20	+5V_AD	A/D converter's supply voltage
21	+5V_AD	A/D converter's supply voltage
22	+5V_AD	A/D converter's supply voltage
23	+5V_AD	A/D converter's supply voltage
24	+5V_AD	A/D converter's supply voltage
25	-	NOT USED
26	ZENA*	Z-motor movement enabled
27	RESET_CCD*	CCD sensor's reset
28	PL_ENA	Position lights enabled
29	HICUR*	High current selection
30	FANPWM	Fan control
31	-	NOT USED
32	-	NOT USED
33	-	NOT USED
34	ROTSW1	Rotation switch 1
35	ROTSW2	Rotation switch 2
36	RXD	Receive data (serial connection)
37	MISO	SPI signal
38	-	NOT USED
39	KEY_STATUS_OK	NOT USED
40	ESTOP	Emergency button status
41	ZACT*	Z-movement activity
42	MIRRORSW	Mirror switch
43	TUBEFAIL*	X-ray tube failure
44	PLSW	Position light switch
45	HL	High/Low bit
46	PLSW	Position light switch
47	HL	High/Low bit
48	EXPSW*	Exposure switch
49	-	NOT USED
50	GND	Ground (logic)

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J509

Pin	Signal	Description
1	+5V_AD	AD converter's supply voltage
2	GND	Ground (logic)
3	VV	Valid video
4	GND	Ground (logic)
5	DS	Data strobe
6	GND	Ground (logic)
7	D0	Data bit 0
8	D1	Data bit 1
9	D2	Data bit 2
10	D3	Data bit 3
11	D4	Data bit 4
12	D5	Data bit 5
13	-	NOT USED
14	GND	Ground (logic)
15	MOSI	SPI signal
16	GND	Ground (logic)
17	SCLK	SPI clock
18	GND	Ground (logic)
19	CS*	Chip select
20	GND	Ground (logic)
21	BEEP	Beeper control
22	MA_REF	Reference current
23	KV_REF	Reference voltage
24	PREH*	Preheat
25	EXPON*	Exposure on
26	GND	Ground (logic)
27	IMAGE	Activates A/D conversion on CCD sensor
28	REGTEMP	Regulator temperature
29	TDICLK	Time Delay Integration clock
30	TXD	Transmit data (serial connection)
31	CCDENA	Activates CCD the supply voltages
32	PPOWER	CCD sensor's supply voltages
33	CLK_1*	Stepper motor clock
34	GND	Ground (logic)
35	DIR*	Stepper motor direction
36	GND	GND (logic)
37	ENA_1*	Stepper motor enable
38	GND	Ground (logic)
39	+5V_AD	AD converter's supply voltage
40	GND	Ground (logic)

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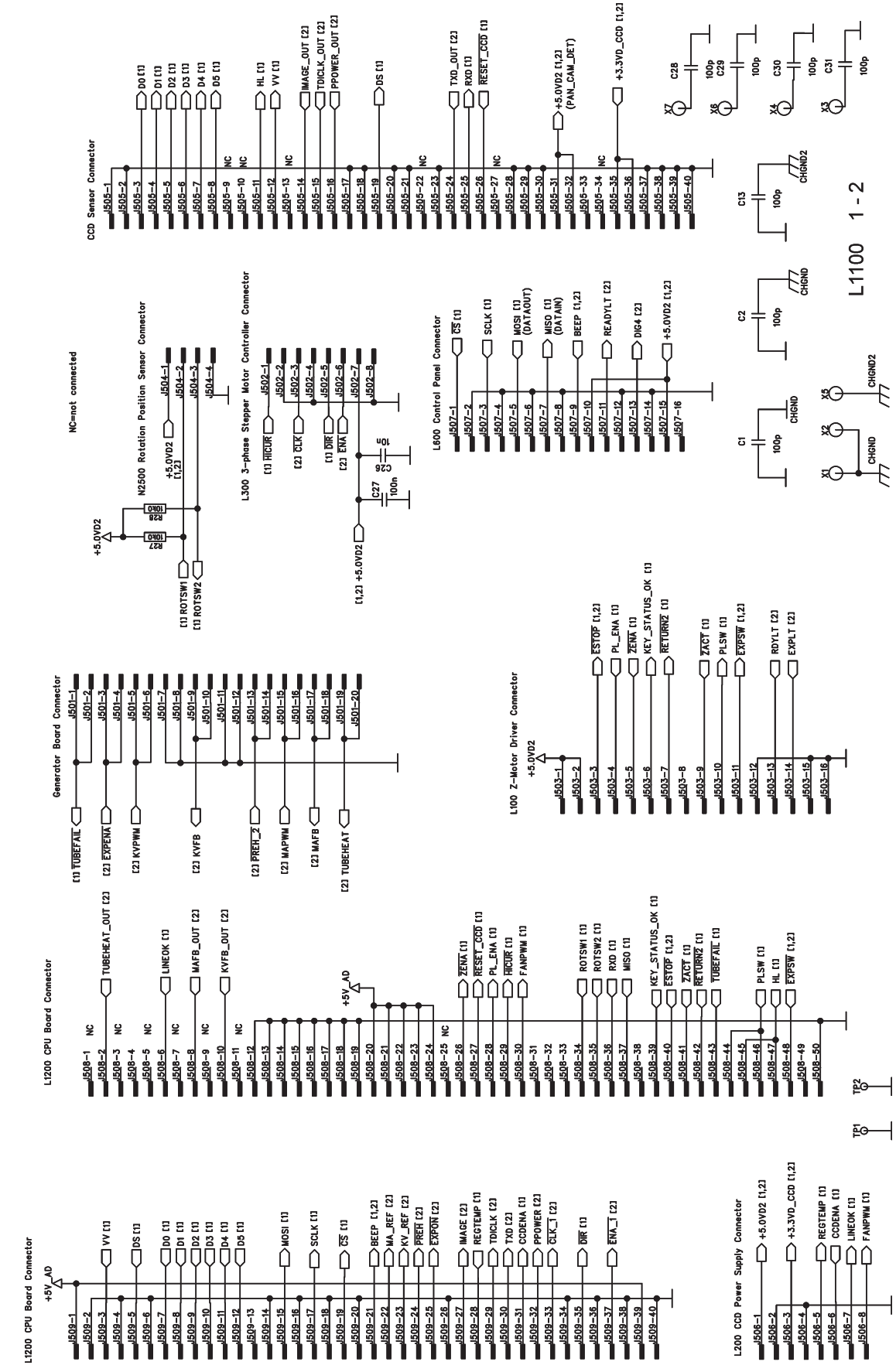

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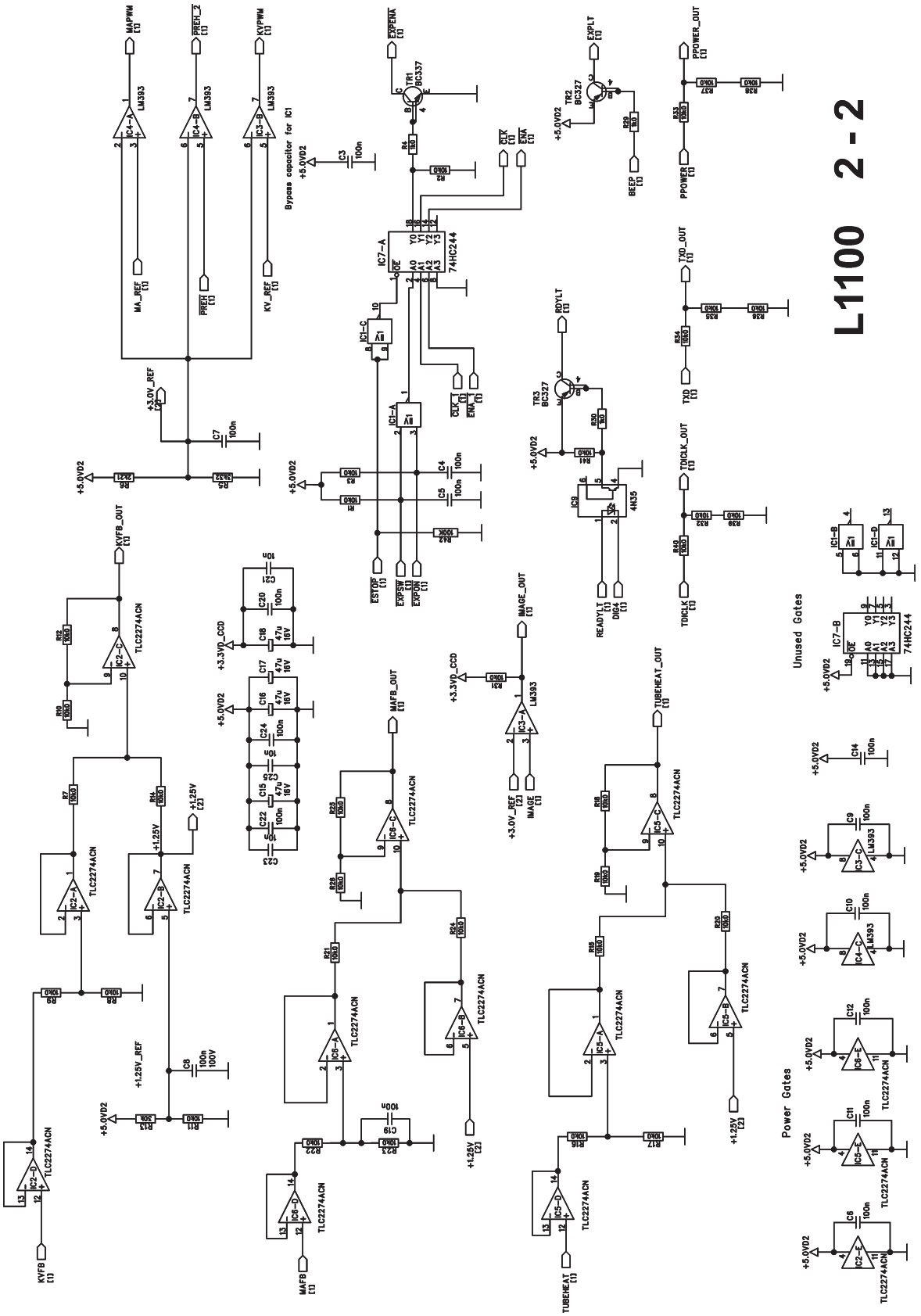

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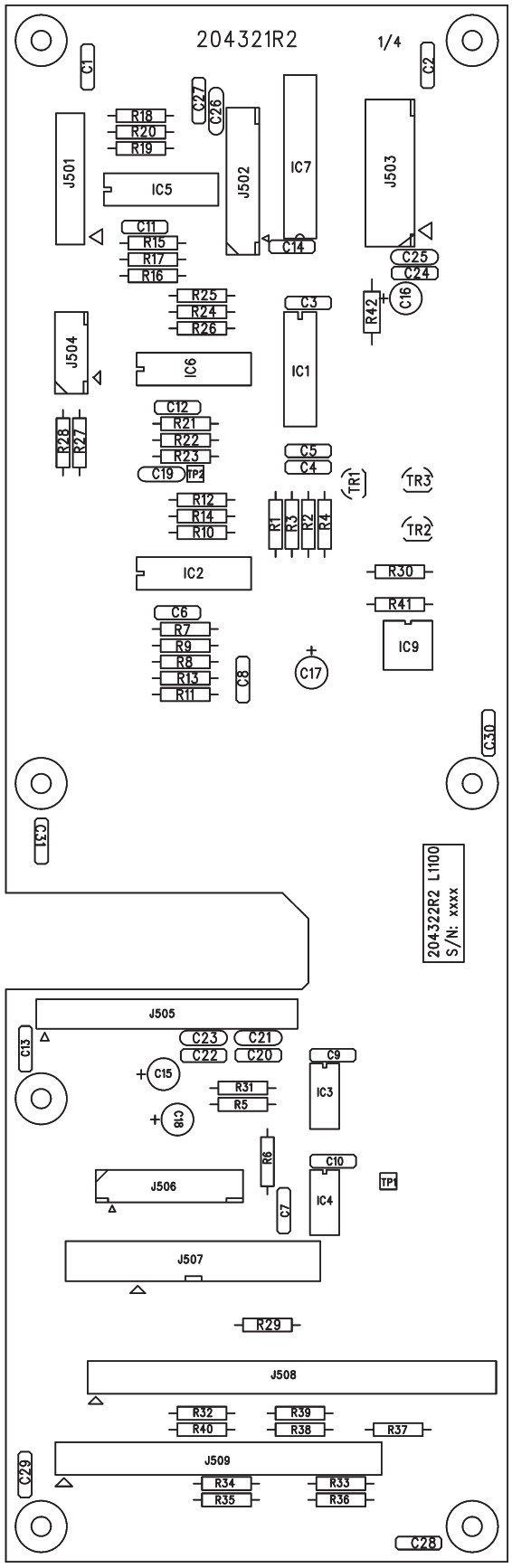
L1100



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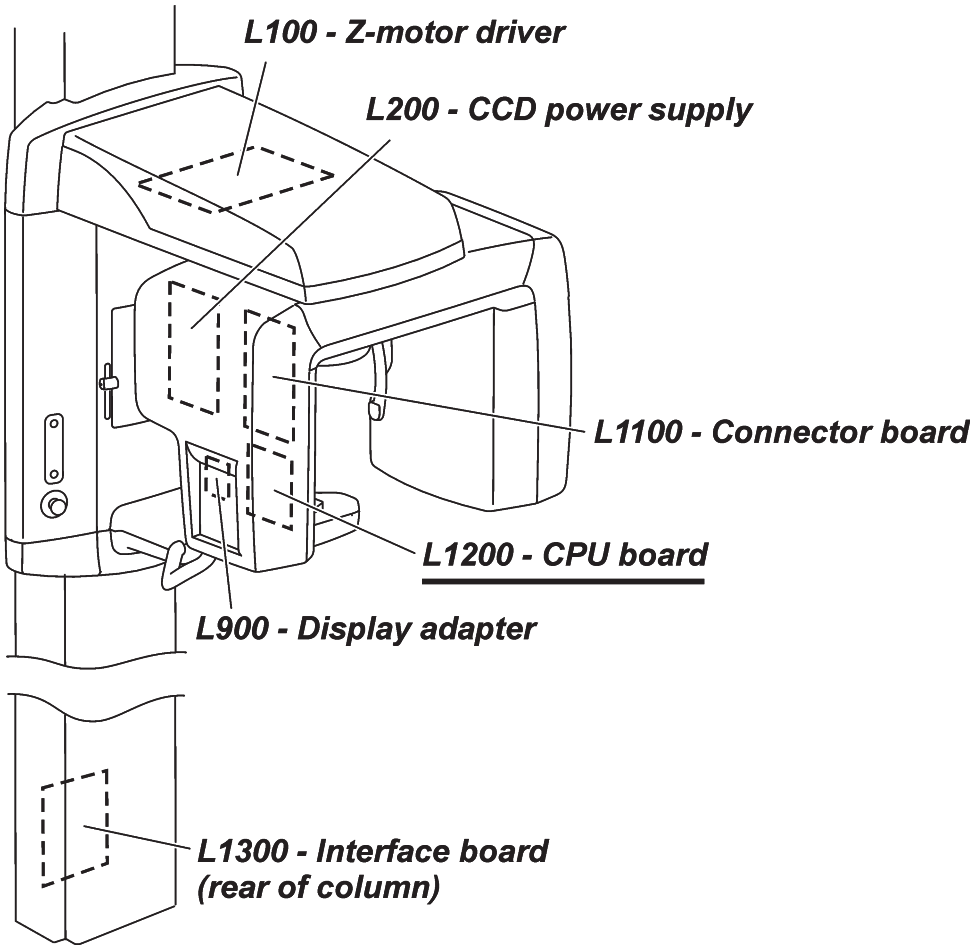
3.6 L1200 CPU Board

L1200 - Location

In rotating unit on the the CCD sensor side. To access remove the sensor external cover (see section 7.1).


L100 - Z-motor driver
L200 - CCD power supply
L1100 - Connector board
L1200 - CPU board
L900 - Display adapter
L1300 - Interface board
(rear of column)

L1200 - Field replaceable parts

None.

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L1200 - Description

The CPU board controls the unit. It controls the rotation and Z movements, the operation of the X-ray tube and reads the signals from the touch panel. It uses an embedded microcontroller on an Altera Cyclone FPGA circuit. The board also has an Ethernet transceiver (for PC connection), I/O buffers, and a 14-bit A/D converter. The image data are saved in an SDRAM.

L1200 - Indicator LEDs

LED	Colour	Indicates
D6	green	+5V on
D8	green	Ethernet signal activity
D9	green	10-Base-T (10Mbit/s) in use
D10	green	100-Base-T (100MBit/s) in use
D11	green	1000-Base-T (1000MBit/s) not supported
D12	green	Full Duplex mode in use
D13	green	+1.2V
D14	green	+1.8V
D20	green	+5V
D23	green	+3.3V
TEST1	green	Flashing = Core functioning
TEST2	green	Flashing = Firmware functioning
TEST3	green	Flashing = Not currently used

L1200 - Connectors

J203_CPU

Pin	Signal	Description
1	+5V_CPU	Power supply CPU
2,4,6	GND	GND (logic)
3	VV	Valid video
5	DS	Data strobe
7	D0	Data bit 0
8	D1	Data bit 1
9	D2	Data bit 2
10	D3	Data bit 3
11	D4	Data bit 4
12	D5	Data bit 5
13	REGTEMP	Temperature of the regulators on L200 board.
14,16,18,20	GND	GND (logic)
15	MOSI	SPI signal

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17	SCLK	SPI clock
19	CS*	Chip select
21	BEEP	Beeper enable
22	mA_ref	Current reference
23	kV_ref	Voltage reference
24	PREH*	Preheat
25	EXPON	Exposure on (CPU enabled)
26,34,36,38	GND	GND (logic)
27	IMAGE	Enables A/D conversion on CCD Sensor Board
28	A/D_2	NOT USED
29	TDI CLK	Time Delay Integration Clock (CCD)
30	TXD	Transmit data (serial connection)
31	CCDENA	Enables the supply voltages for the CCD sensor
32	PPOWER	CCD sensor's supply voltages are on
33	CLK	Stepper motor clock
35	DIR	Stepper motor direction
37	ENA	Stepper motor enabled
39	+5V_CPU	CPU Power supply CPU
40	GND	GND (logic)
41-50	-	NOT CONNECTED

J205_CPU

Pin	Signal	Description
1	+5V	Power supply (logic)
2	GND	GND (logic)

J208

LCD data.

J209

Pin	Signal	Description
1	A+	Ethernet, twisted pair 0
2	A-	Ethernet, twisted pair 0
3	B+	Ethernet, twisted pair 1
4	C+	Ethernet, twisted pair 2

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5	C-	Ethernet, twisted pair 2
6	B-	Ethernet, twisted pair 1
7	D+	Ethernet, twisted pair 3
8	D-	Ethernet, twisted pair 3

J3_CPU

Pin	Signal	Description
1	-	NOT USED
2	TUBEHEAT	The X-ray tube's temperature (analog signal)
3	-	NOT USED
4	A/D_1	NOT USED
5	-	NOT USED
6	LINEOK	Line voltage
7	-	NOT USED
8	mAfb	mA feedback
9	-	NOT USED
10	kVfb	kV feedback
11	-	NOT USED
12-19	GNDA	A/D converter's ground
20-24	+5VA	A/D converter's supply voltage
25	-	NOT USED
26	ZENA*	Z-motor movement enabled
27	RESET_CCD*	Resets CCD sensor
28	PL_ENA	Position lights enabled
29	HICUR*	High current selection
30	FAN_PWM	Temperature controlled fan
31	OUT1	NOT USED
32	OUT2	NOT USED
33	OUT3	NOT USED
34	ROTSW1	Rotation position switch signal
35	ROTSW2	Rotation position switch signal
36	RXD	Receive data (serial connection) from CCD
37	MISO	SPI signal
38	-	NOT USED
39	KEY_STATUS_OK	NOT USED
40	ESTOP	Emergency stop switch status (NOT USED)
41	ZACT*	Up/down key on side control panel pressed
42	MIRRORSW	Mirror switch
43	TUBEFAIL*	X-ray tube failure
44	-	NOT USED
45	-	NOT USED
46	PLSW	Position light switch
47	HL	High/low bit
48	EXPSW*	Exposure switch
49	+3V3	Power supply
50	GND	Ground (logic)

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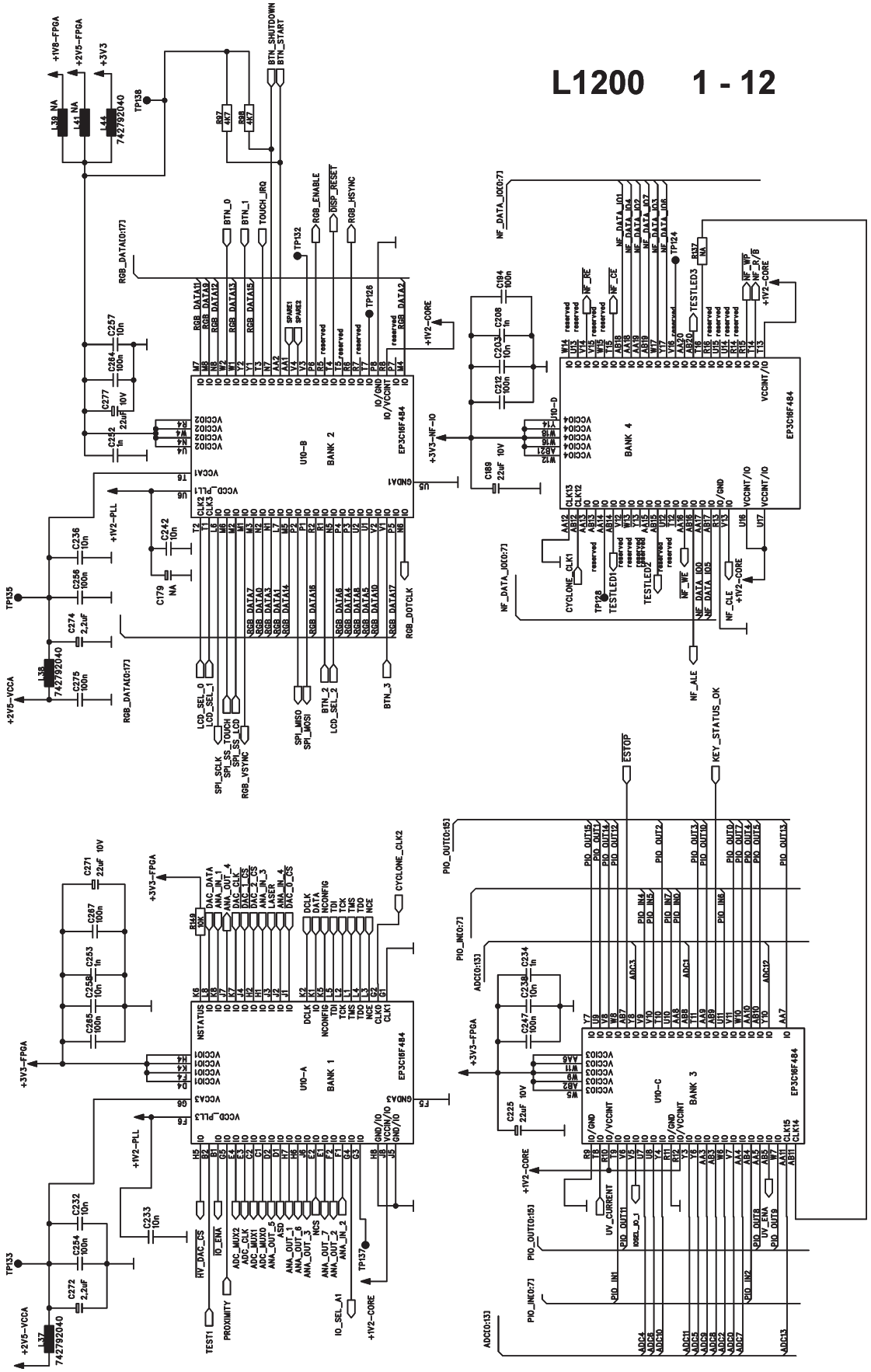

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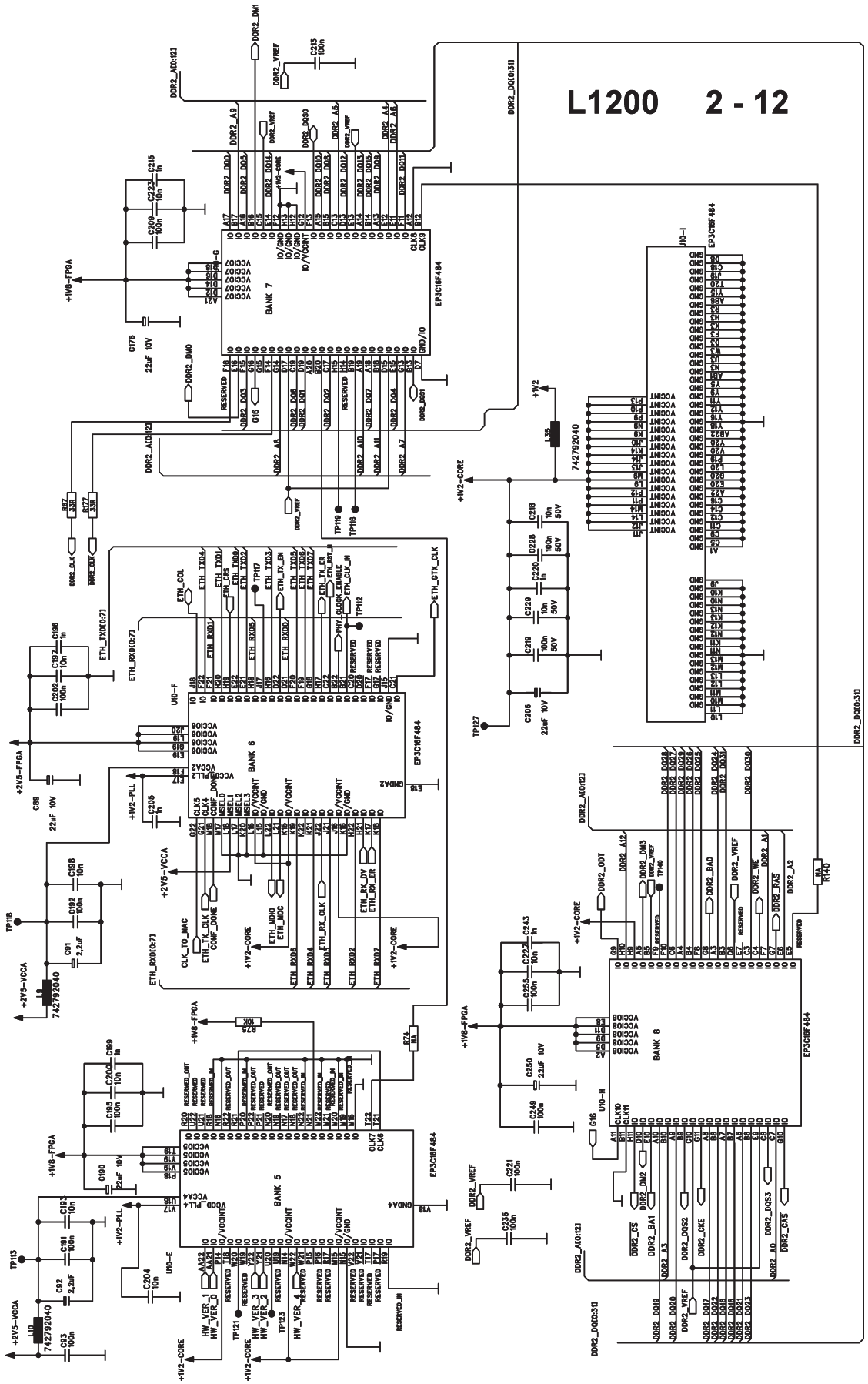

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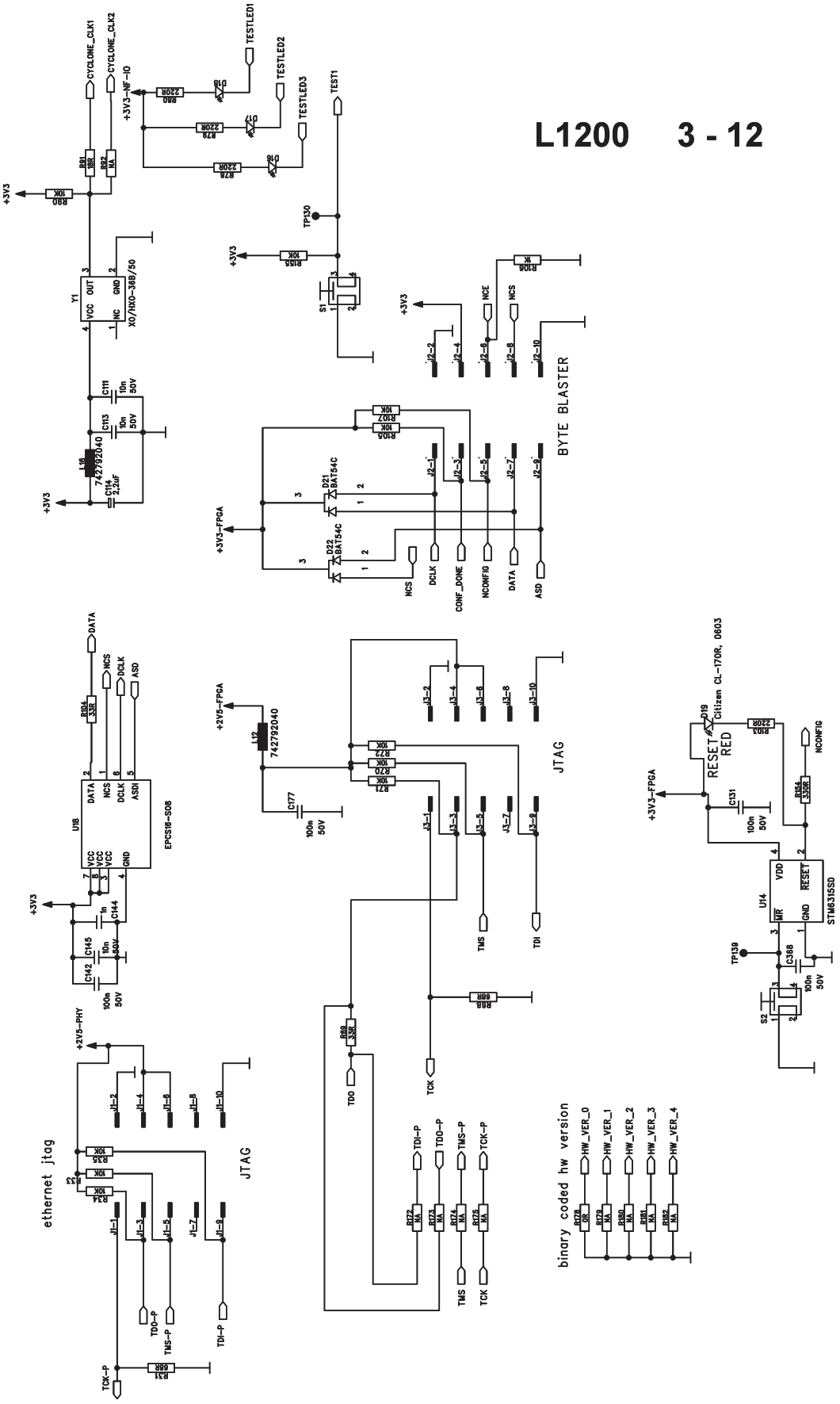

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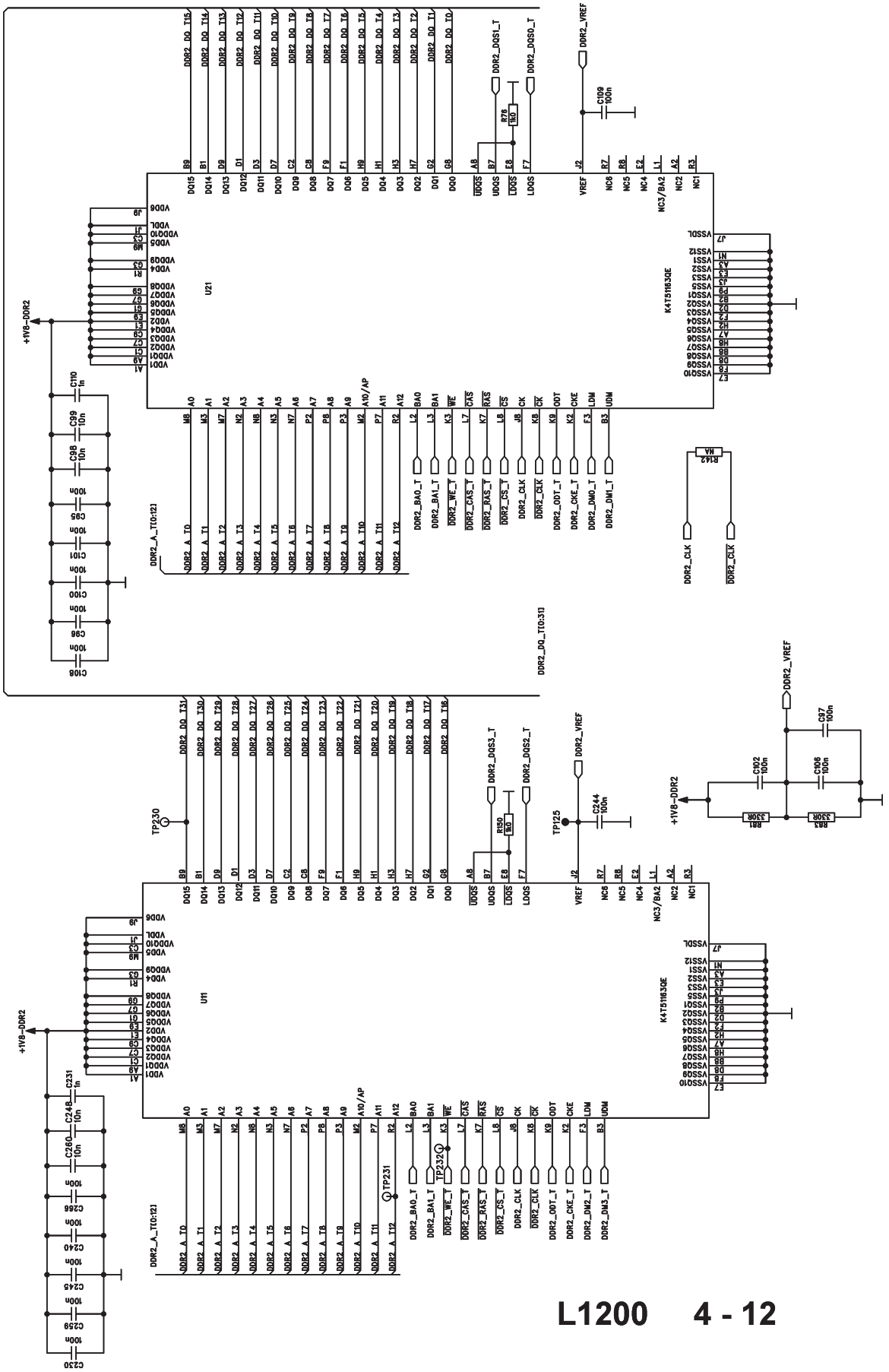

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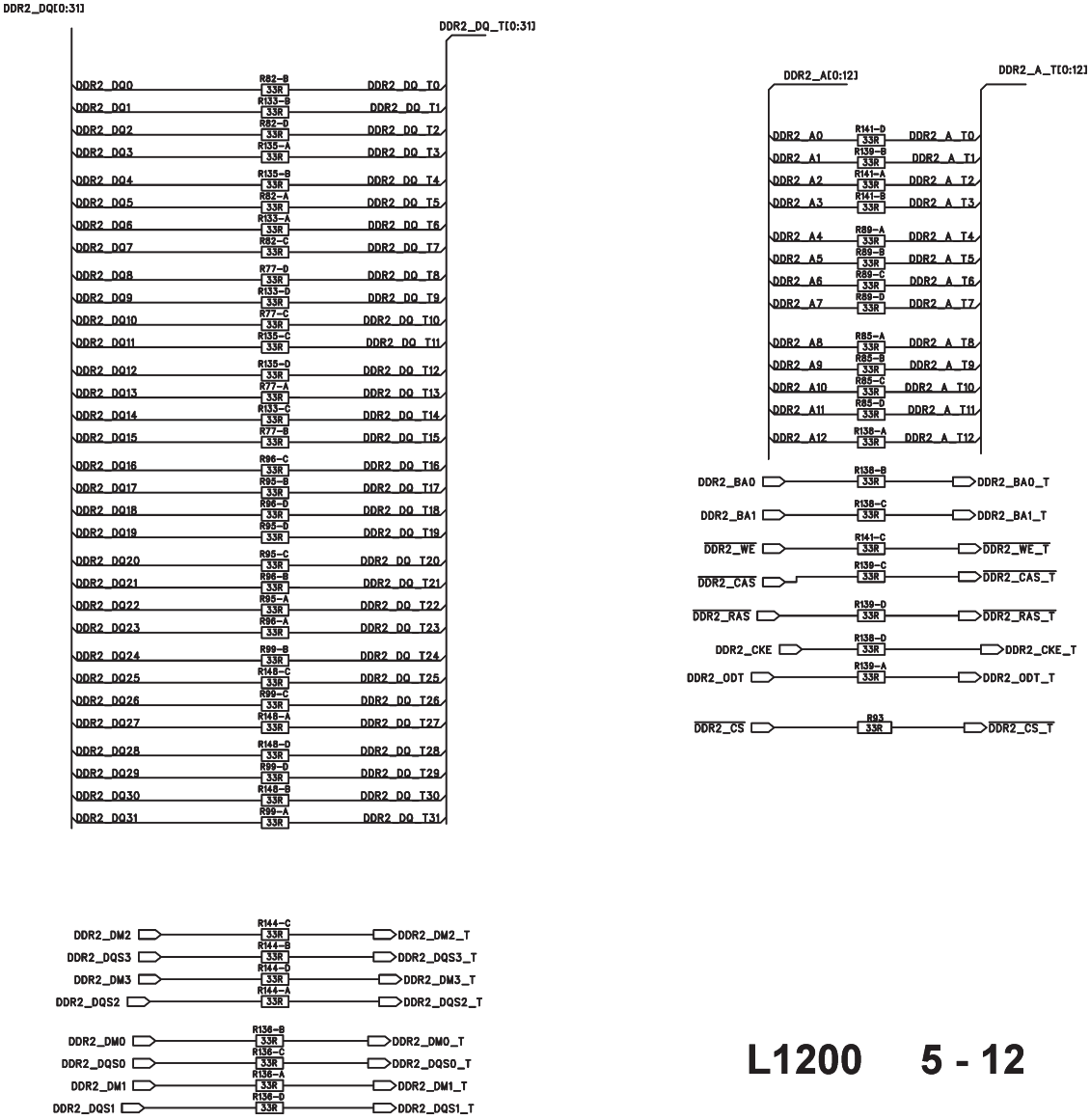

L1200 5 - 12

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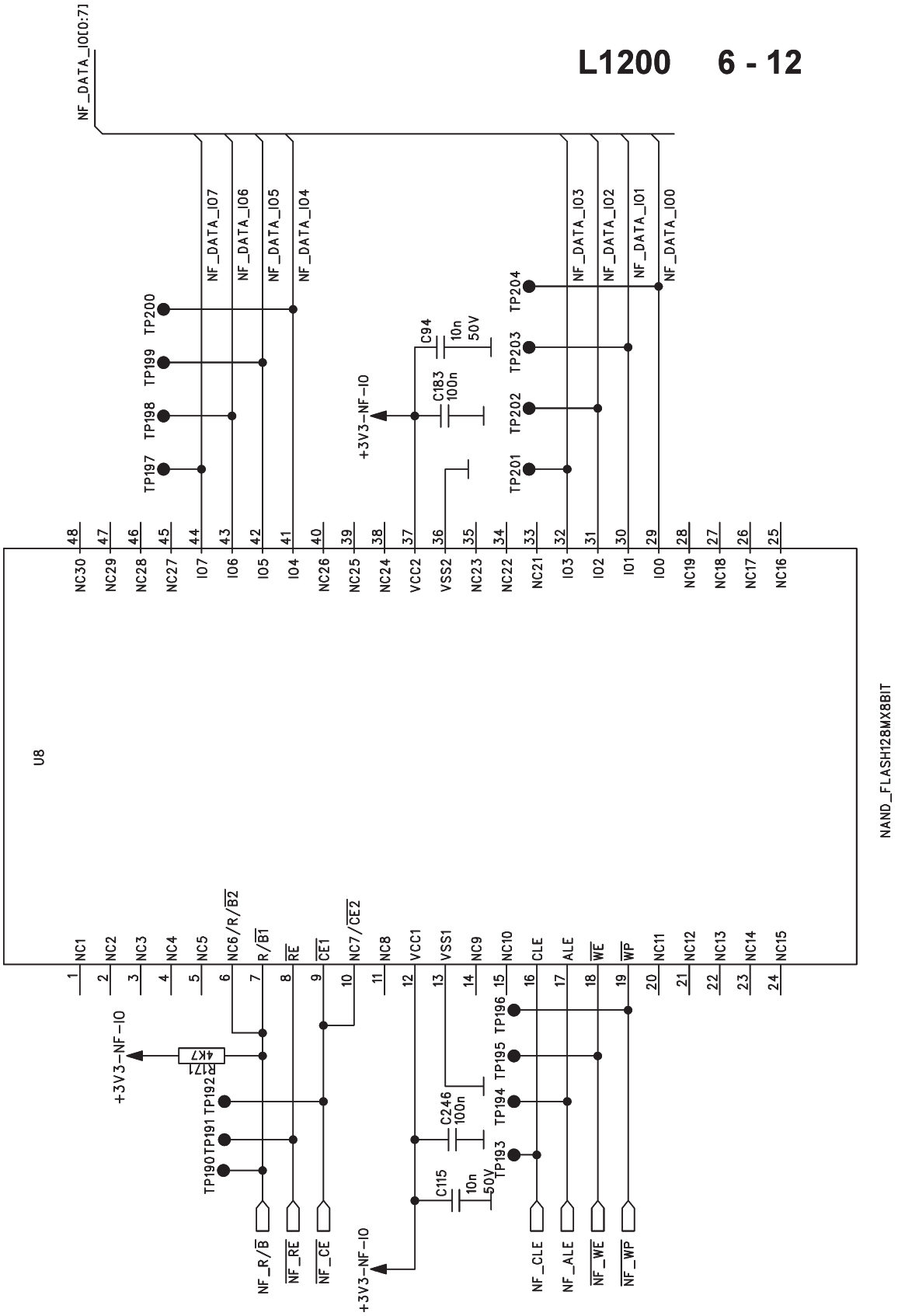
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U8
NAND_FLASH128MX8BIT
NC1 NC2 NC3 NC4 NC5 NC6/R/B2 R/B1 RE CE1 NC7/CE2 NC8 VCC1 VSS1 NC9 NC10 CLE ALE WE WP NC11 NC12 NC13 NC14 NC15
NC30 NC29 NC28 NC27 IO7 IO6 IO5 IO4 NC26 NC25 NC24 VCC2 VSS2 NC23 NC22 NC21 IO3 IO2 IO1 IO0 NC19 NC18 NC17 NC16
TP200 TP199 TP198 TP197
TP204 TP203 TP202 TP201
NF_DATA_IO7 NF_DATA_IO6 NF_DATA_IO5 NF_DATA_IO4
NF_DATA_IO3 NF_DATA_IO2 NF_DATA_IO1 NF_DATA_IO0
+3V3-NF-IO
C94 10n 50V
C183 100n
R171 4K7
TP192 TP191 TP190
C246 100n
C115 10n 50V
TP196 TP195 TP194 TP193
NF_R/B NF_RE NF_CE
NF_CLE NF_ALE NF_WE NF_WP

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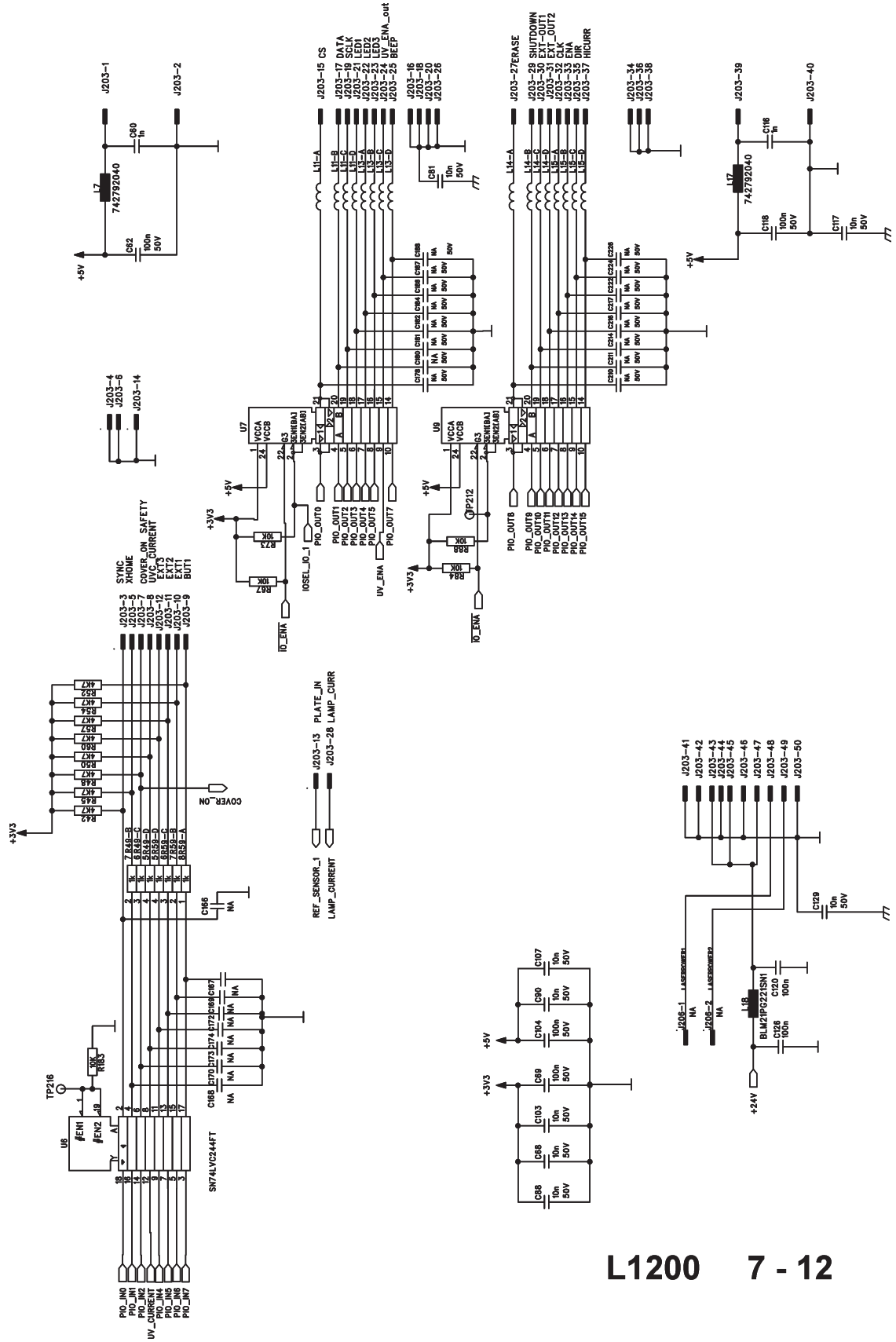

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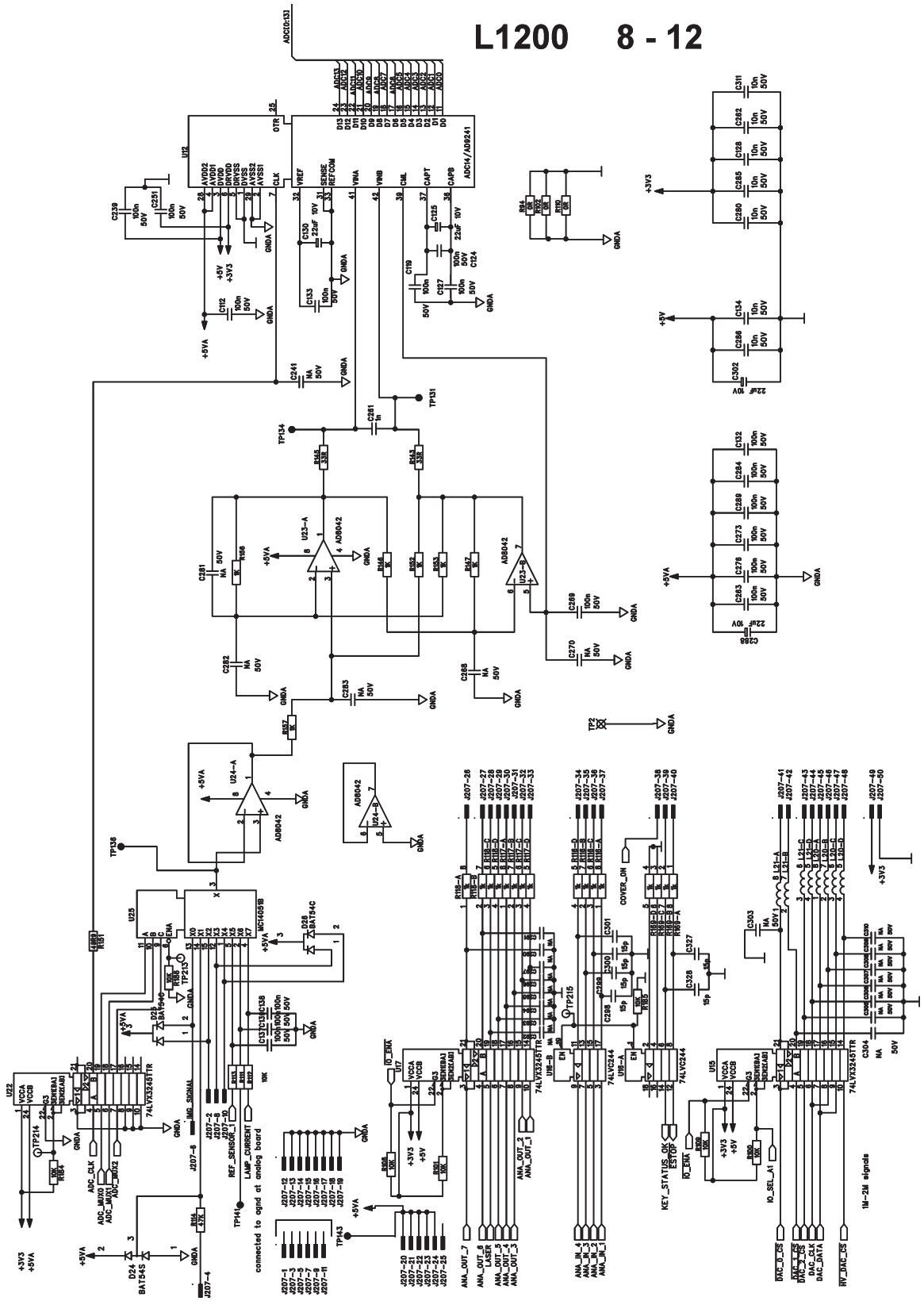

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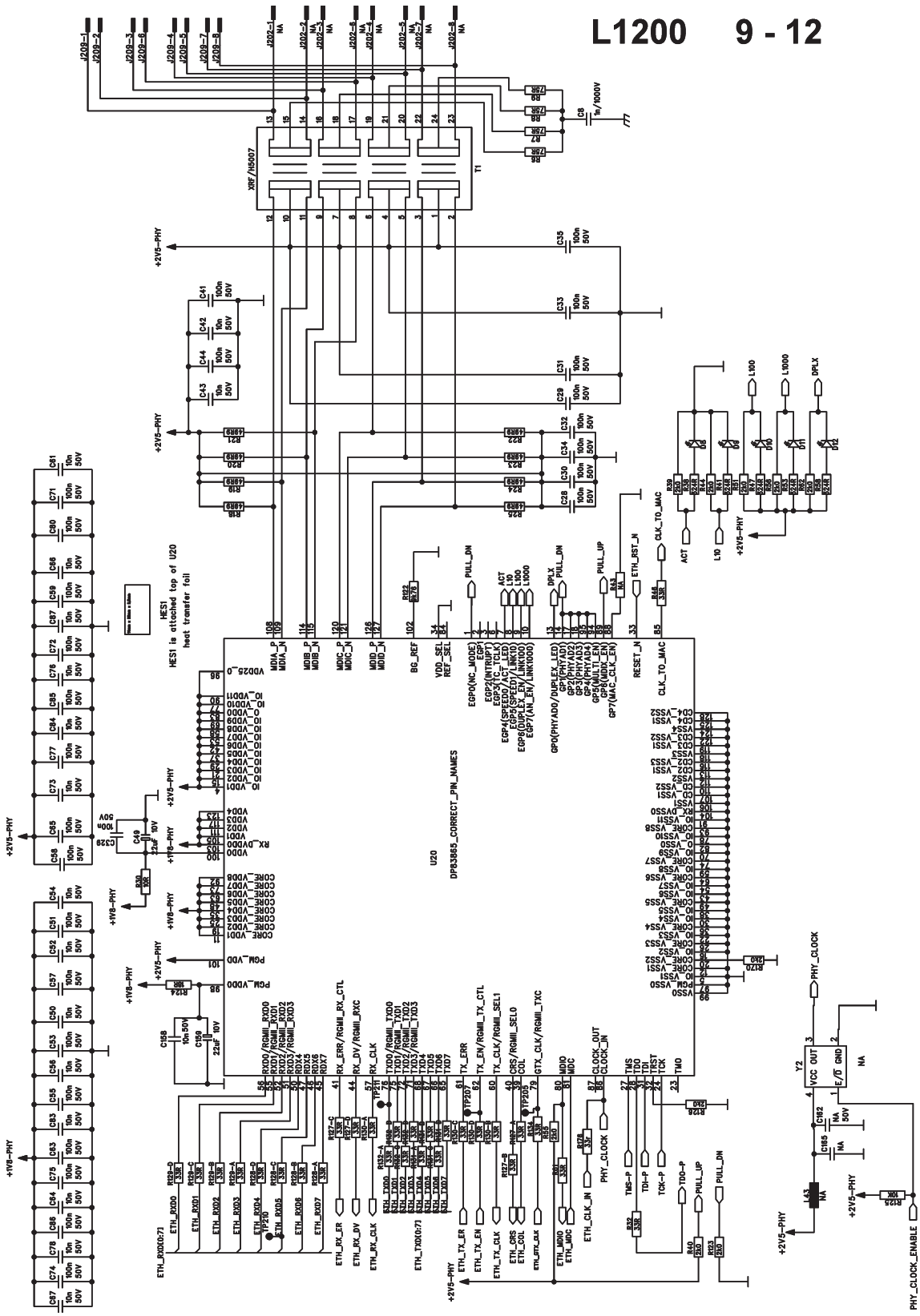

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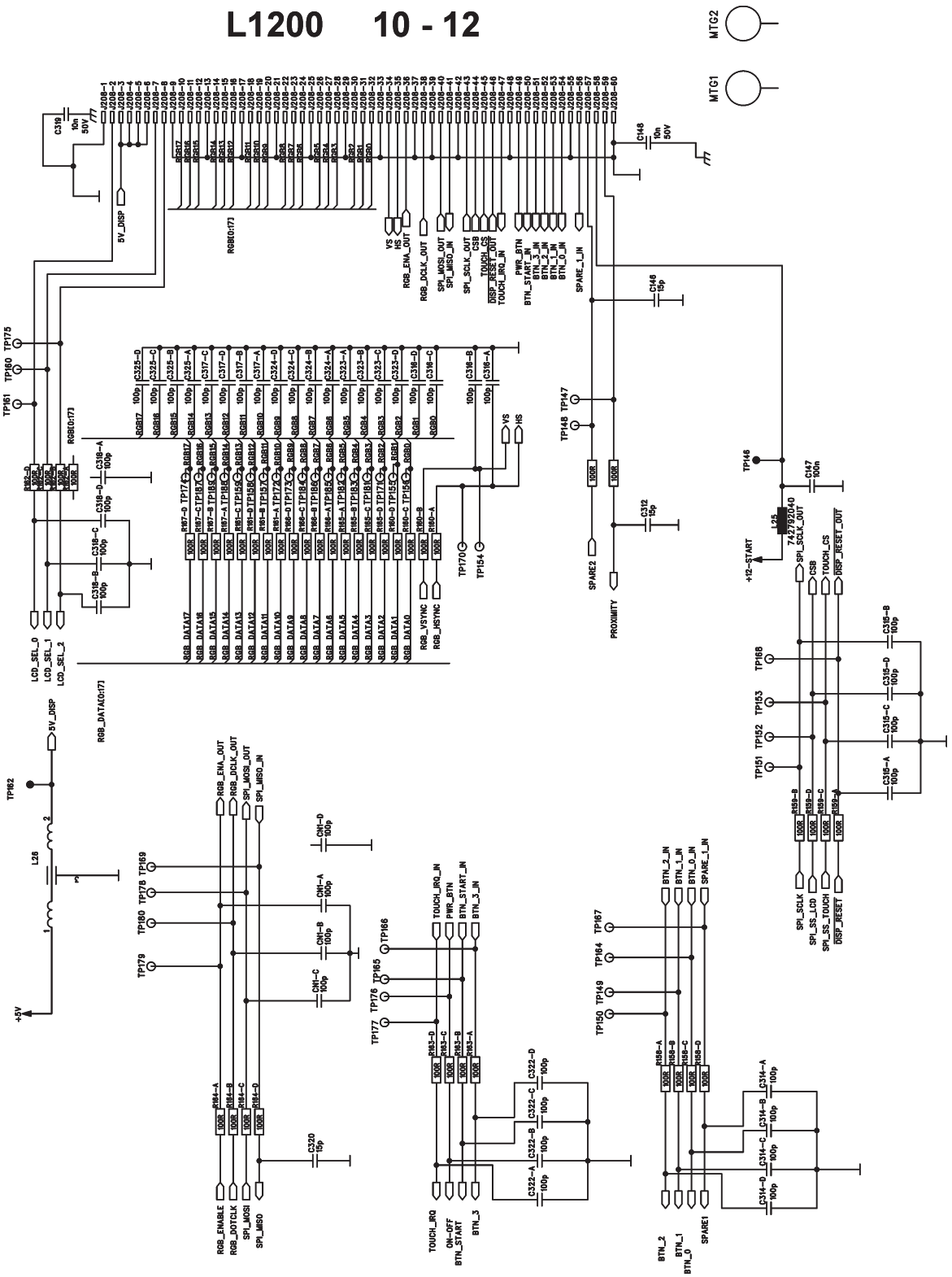
L1200 10 - 12



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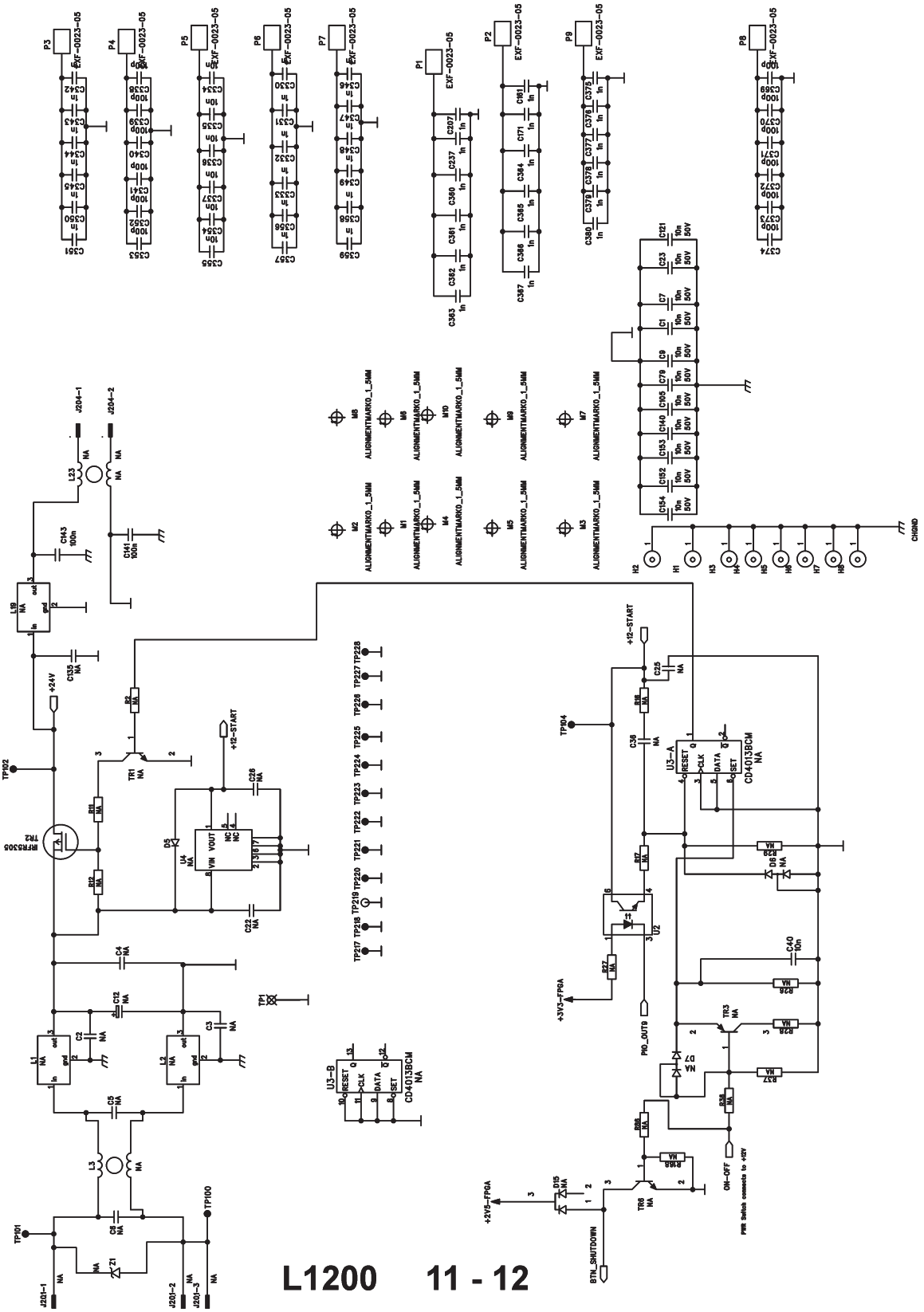

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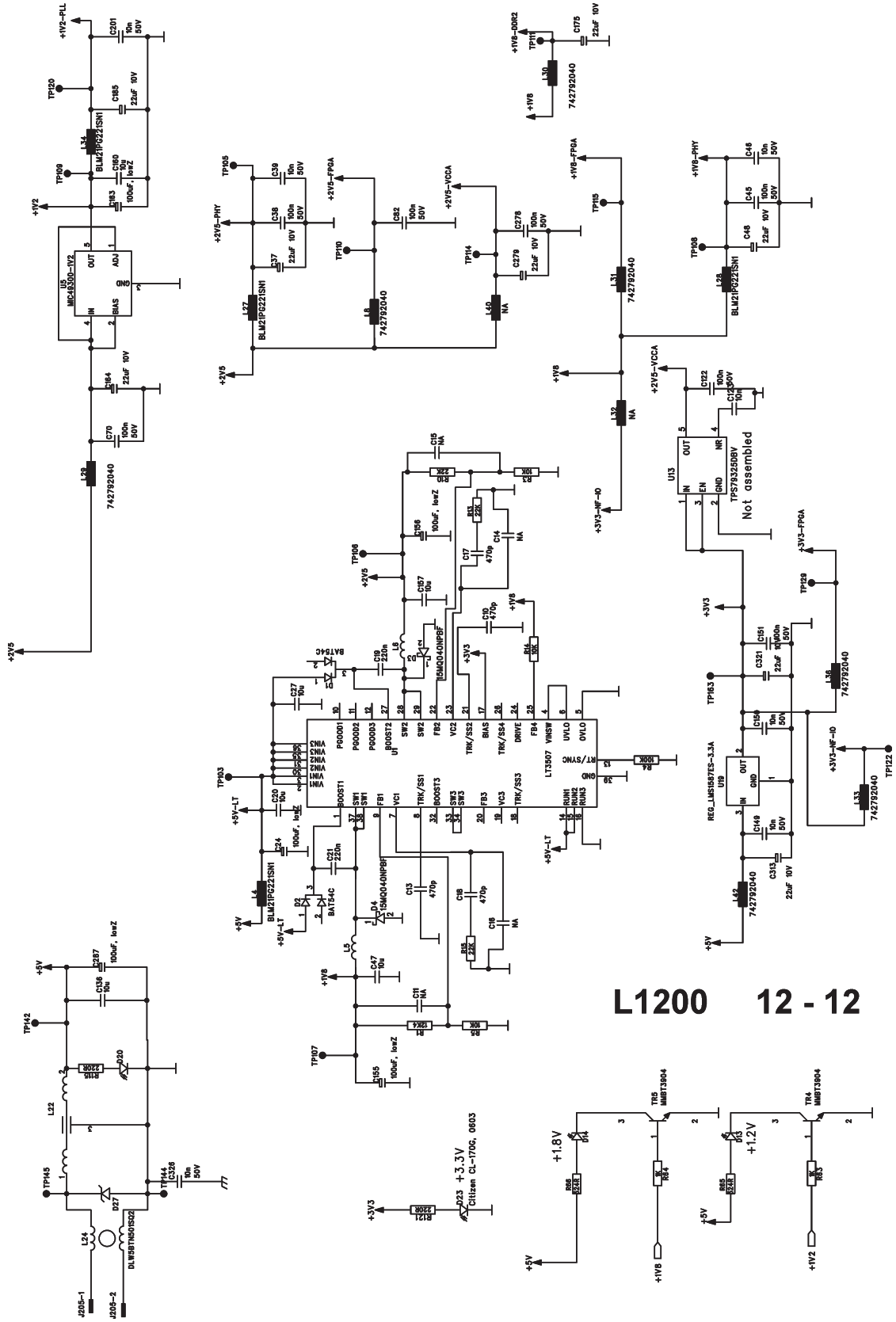

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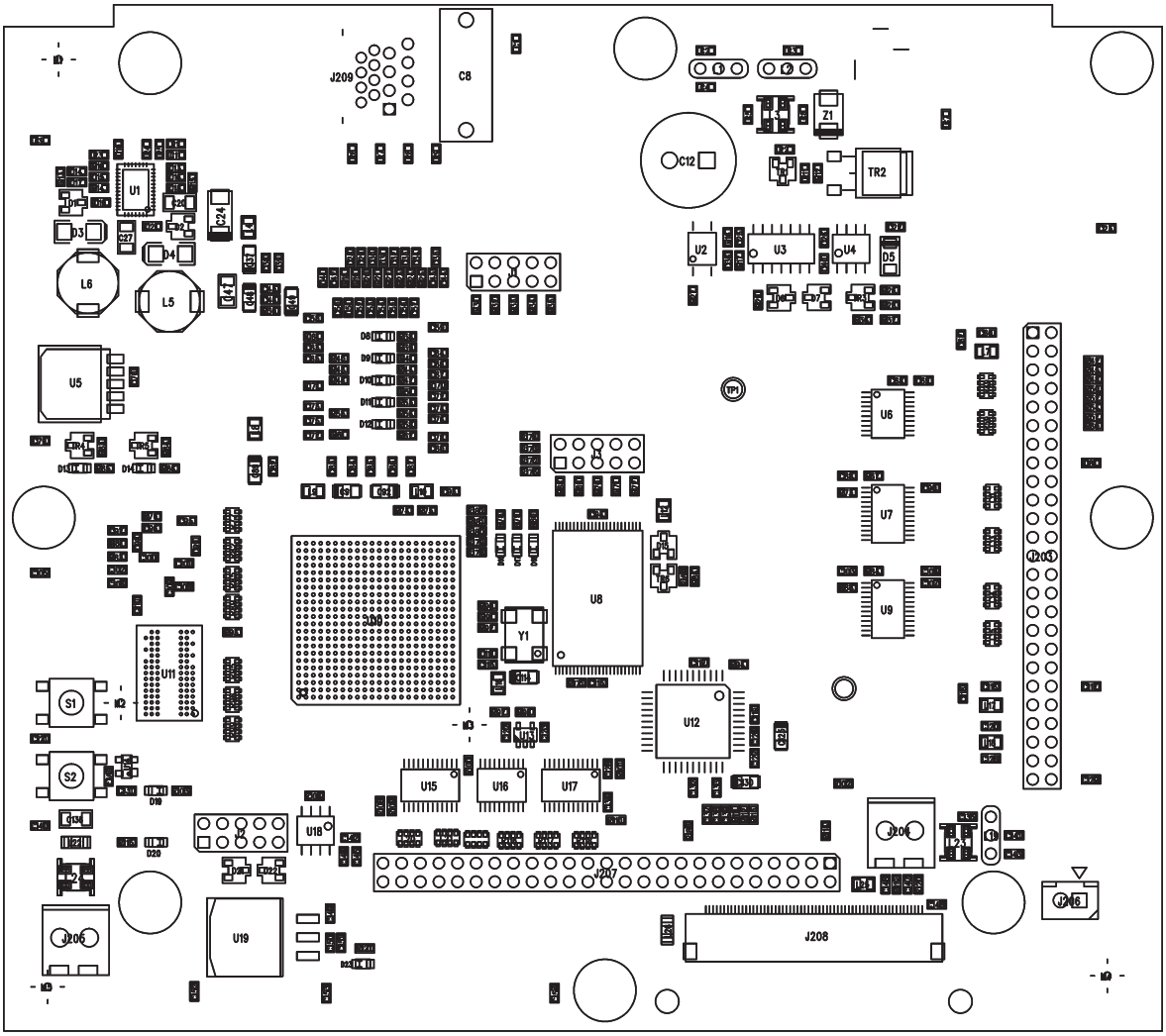

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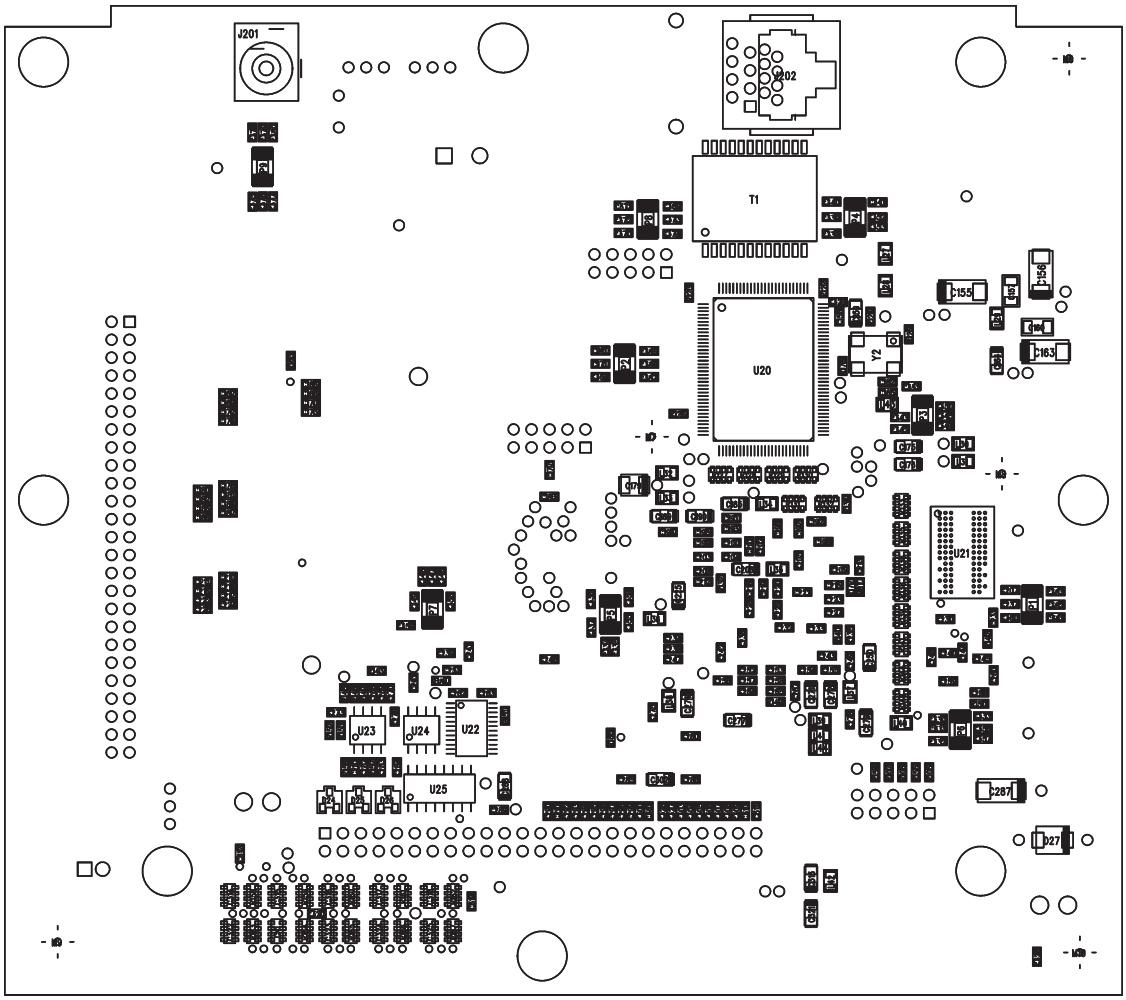

L1200

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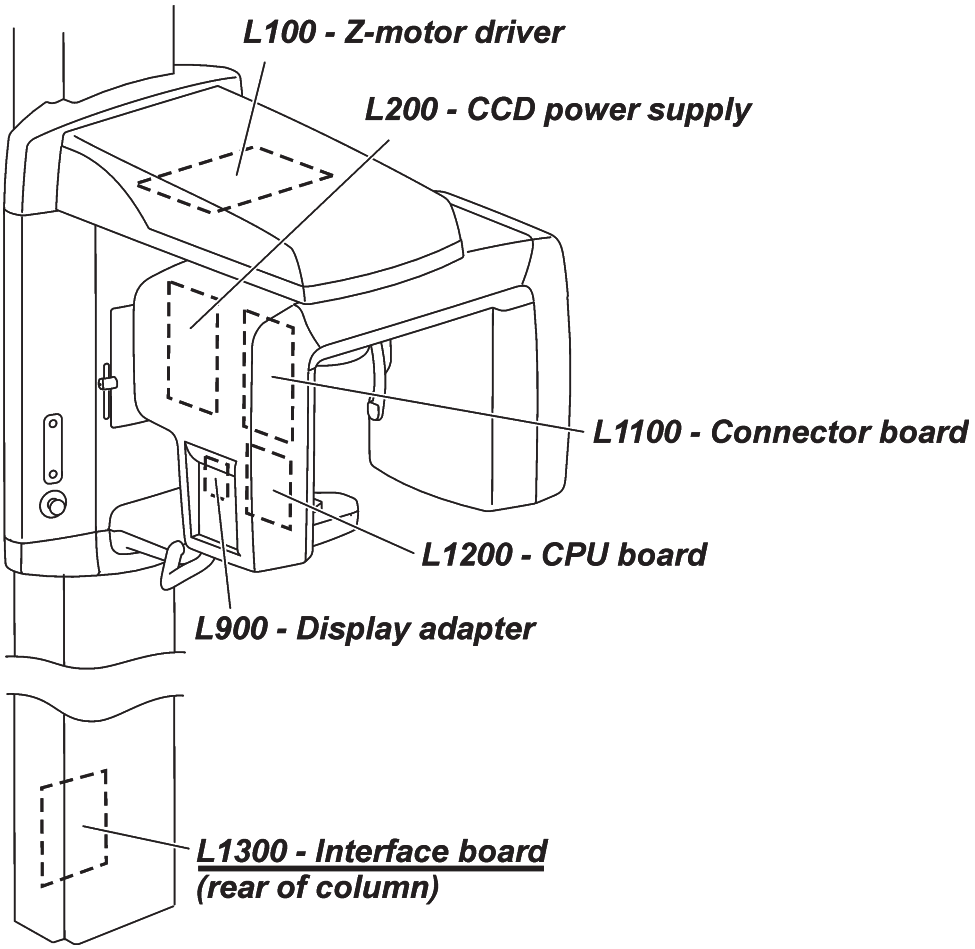
3.7 L1300 Interface Board

L1300 - Location

At the rear of the column near the base.


L100 - Z-motor driver
L200 - CCD power supply
L1100 - Connector board
L1200 - CPU board
L900 - Display adapter
L1300 - Interface board
(rear of column)

L1300 - Field replaceable parts

None.

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L1300 - Description

L1300 serves as an external interface to the outside environment. The Ethernet cable that goes to the PC and the exposure button cable are connected to this board.

L1300 - Connectors

J701

Pin	Signal	Description
1	EXPSW*	Exposure switch
2	READYLT	Ready light
3	EXPLT	Exposure light
4	GND	Ground
5	+5V	+5V power supply
6	GND	Ground

J702

Not used

J703

Pin	Signal	Description
1	EXPSW*	Exposure switch
2	READYLT	Ready light
3	EXPLT	Exposure light
4	GND	Ground
5	+5v	
6	GND	Ground

J704

Pin	Signal	Description
1	EXPSW*	Exposure switch
2	READYLT	Ready light
3	EXPLT	Exposure light
4	GND	Ground
5	+5V	NOT USED
6	GND	Ground

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J705

No used

J706

Not used

J709

Pin	Signal	Description
1		External warning light
2		External warning light

J710

Pin	Signal	Description
1	EXPSW	Exposure switch
2	GND	Ground

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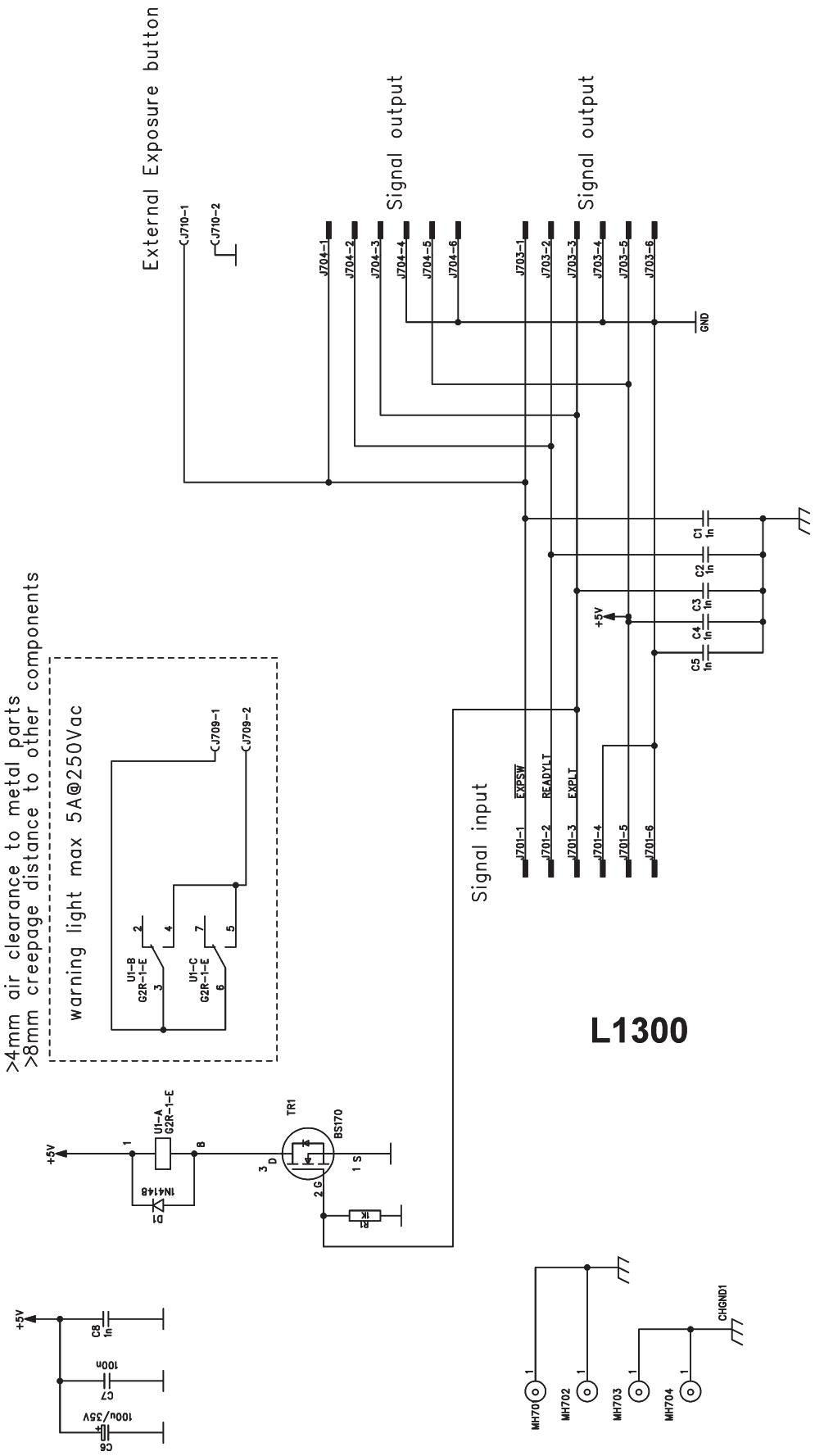

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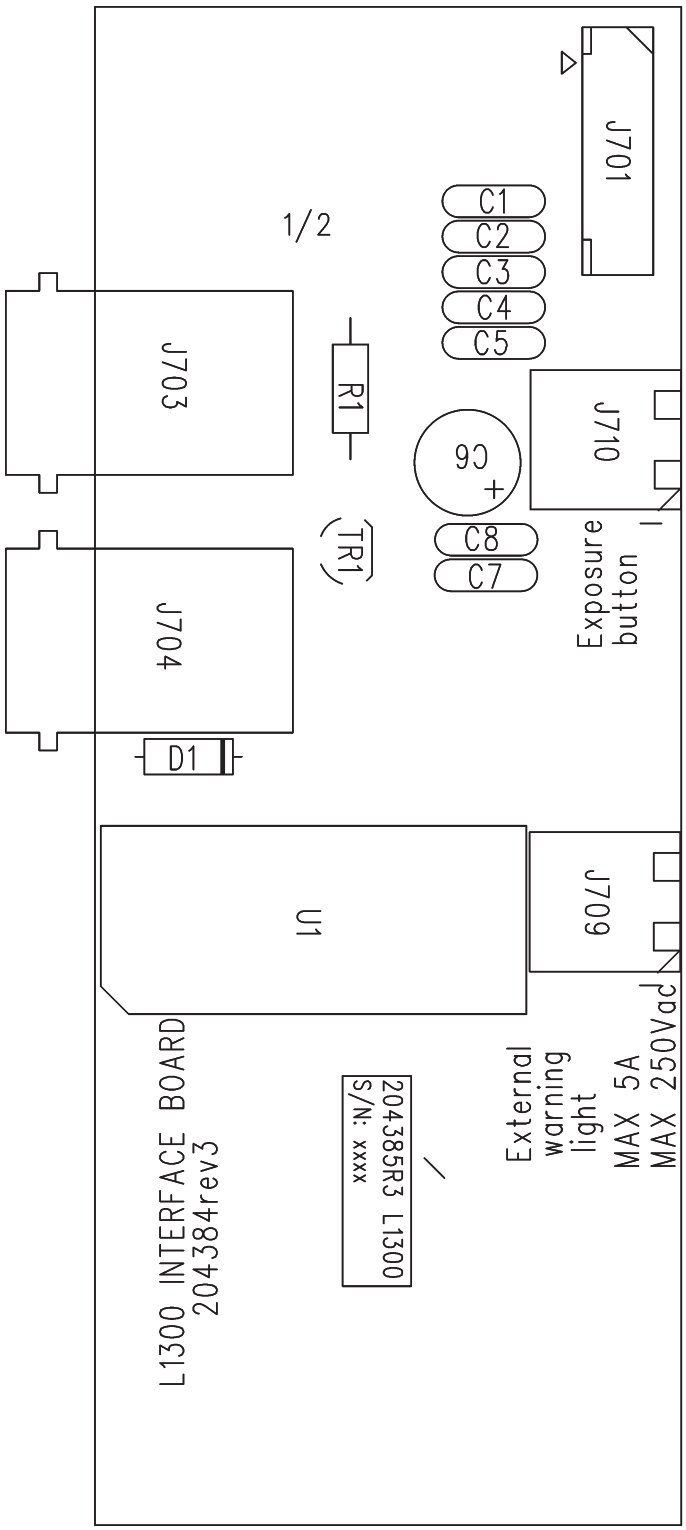

L1300

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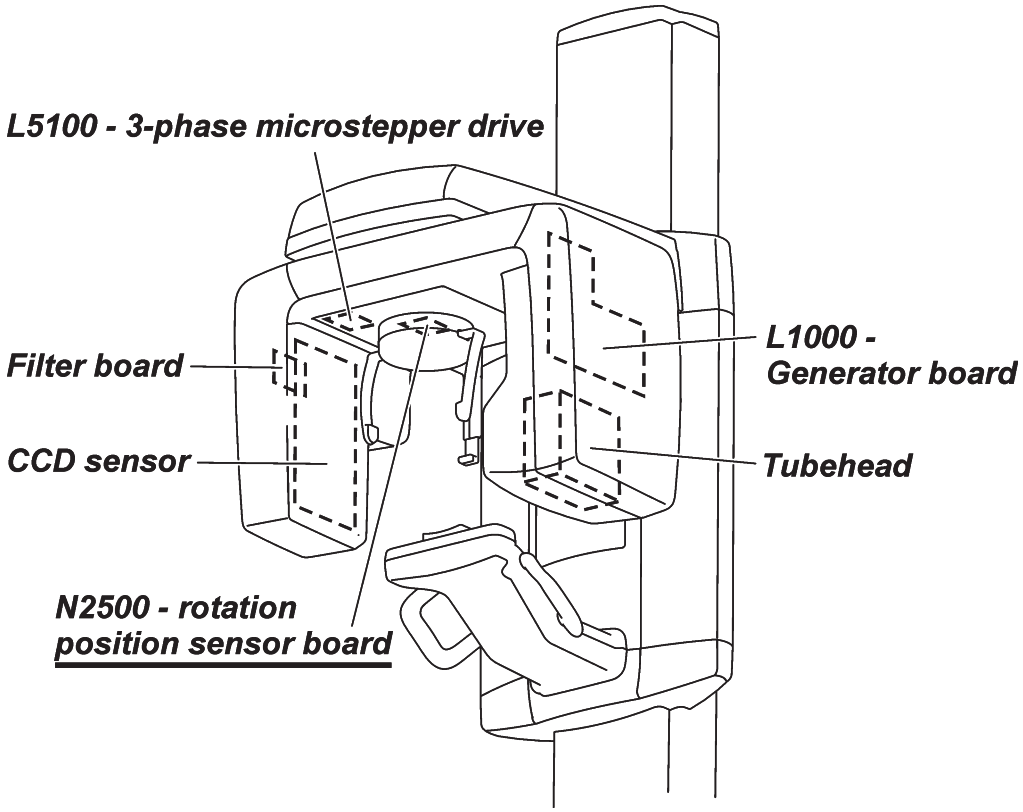
3.8 N2500 Rotation Position Sensor Board

N2500 - Location

Inside the rotating unit under the head support. To access, remove the head support and then the lower protective cover (see section 7.1).



N2500 - Field replaceable parts

None.

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N2500 - Description

N2500 is used to detect the position of the rotating unit. N2500 has two optical switches that generate sensor signals ROTSW1 and ROTSW2 according to which position is activated.

N2500 includes a transmitter LED, and a receiver, or base. The sensor signals remain on as long as the base receives light from the LED. When the light to the base is cut off by the positioning rail, the sensor signal is switched off.

N2500 - Connectors

J2501

Pin	Signal	Description
1	+5V	Supply voltage
2	ROTSW1	Sensor signal 1
3	ROTSW2	Sensor signal 2
4	GND	Ground

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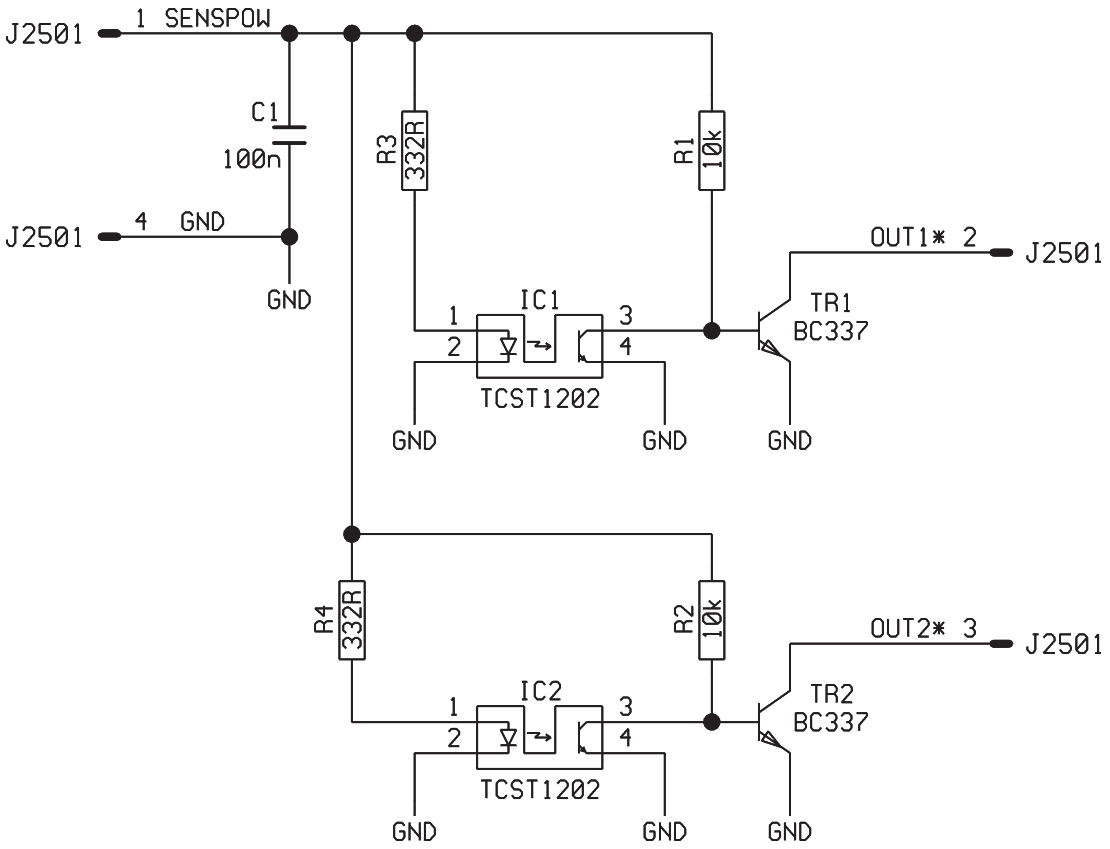

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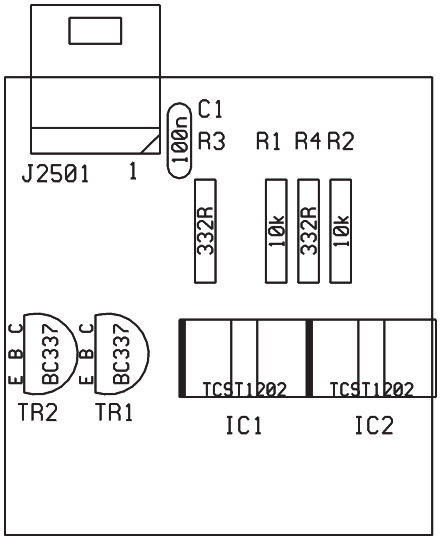

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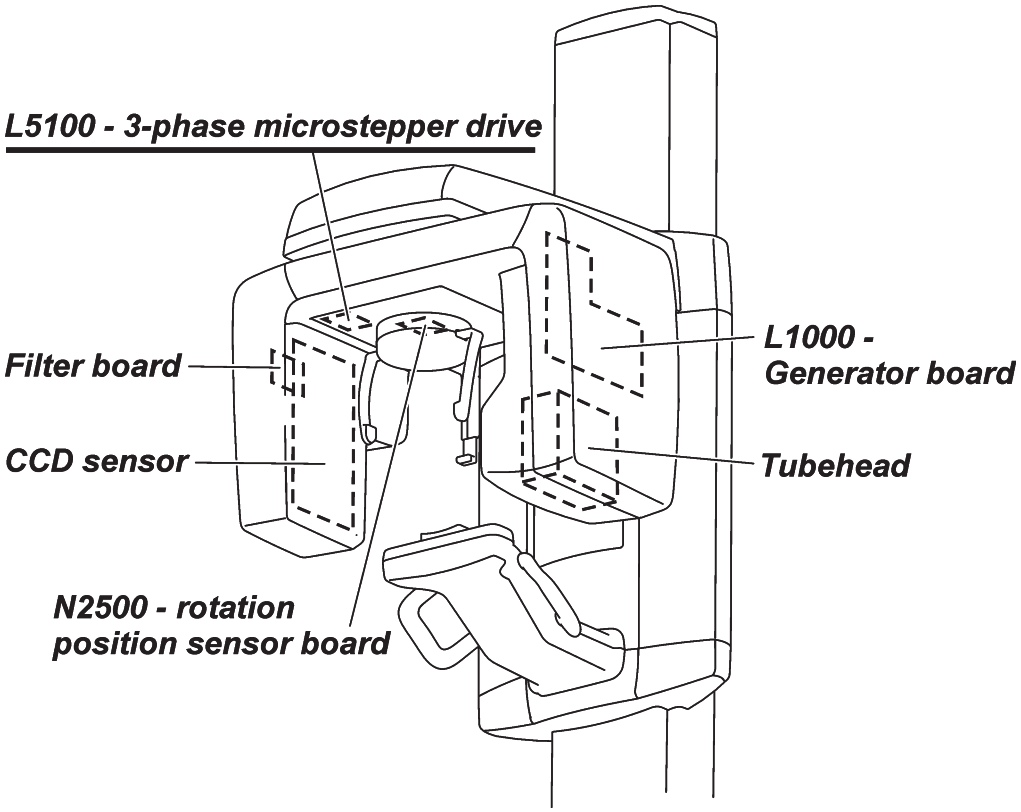
3.9 R5100, 3-Phase Microstepper Driver

R5100 - Location

Inside the rotating unit, above the head support. To access, remove the head support, lower protective cover (see section 7.1).



R5100 - Field replaceable parts

None.

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R5100 - Description

R5100 controls the 3-phase stepper motor that drives the Rotating Unit. The board receives in three control signals: clock, dir, and ena. It produces phase voltages for the stepper motor windings.

R5100 - Indicator LEDs

LED	Colour	Indicates
D1	green	+5V on
D2	green	+24V on

R5100 - Test Points

Number	Description	Value
TP1	GND	0V
TP2	VREF	0.97V ±0.1V; when HICUR* = '1' 1.95V ±0.1V; when HICUR* = '0' (default value)
TP3	CLK	+5V freq <15kHz
TP4	ENA	+5V active, 0V idle
TP5	DIR	+5V when idle or when moving to the PIO position. 0V when driving to end position.
TP6	PGND	0V

R5100 - Connectors

R5101

Pin	Signal	Description
1,3	+24V	Power supply
2,4	PGND	Power GND
5,6	-	NOT CONNECTED
7,9,11,13,15	GND	Ground (logic)
8	HICUR*	High current selection
10	CLK*	Stepper motor clock
12	DIR*	Stepper motor direction
14	ENA*	Stepper motor enabled
16	+5V	Power supply (logic)

R5102

Pin	Signal	Description
1	Phase #1	Stepper motor driver's phase voltages
2	Phase #2	Stepper motor driver's phase voltages
3	Phase #3	Stepper motor driver's phase voltages

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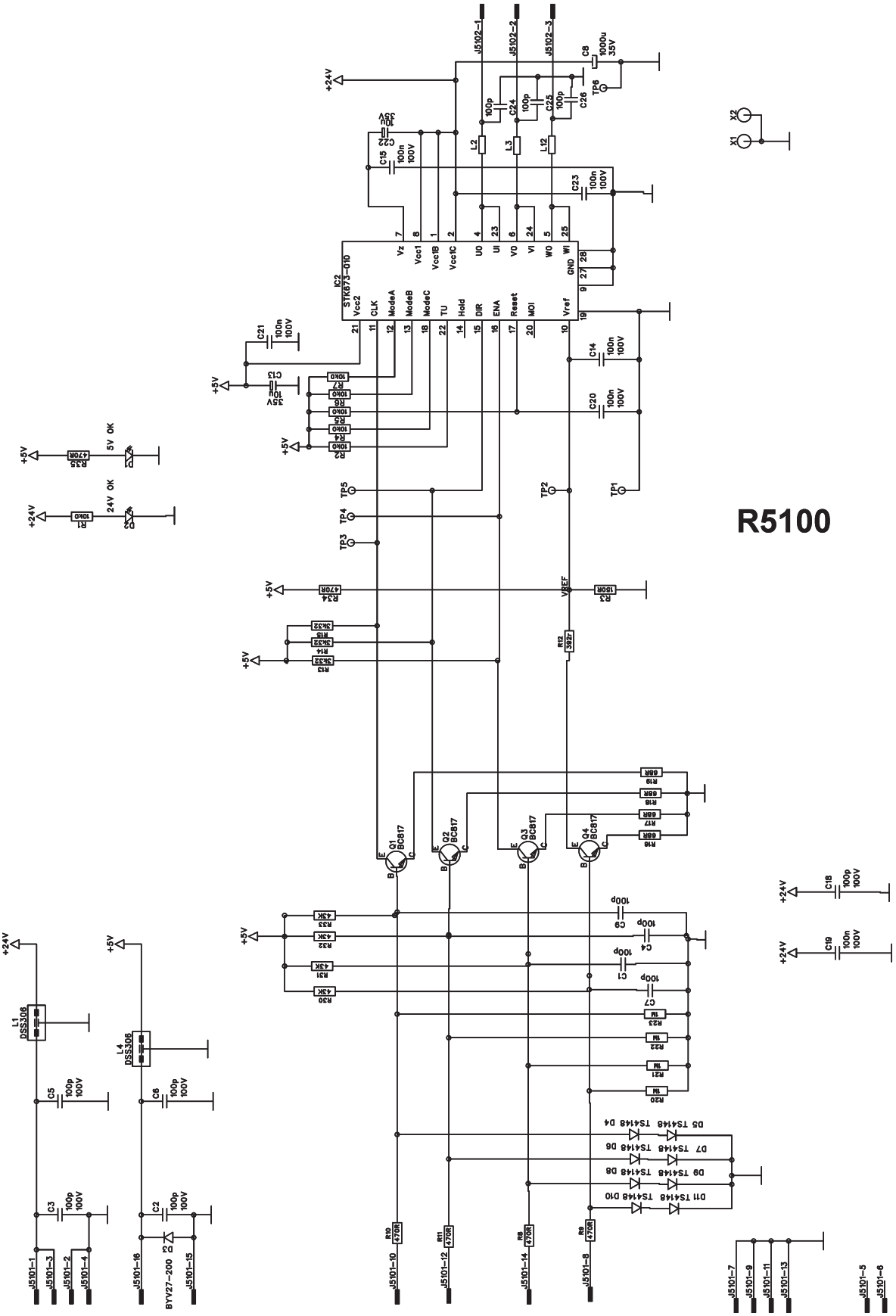

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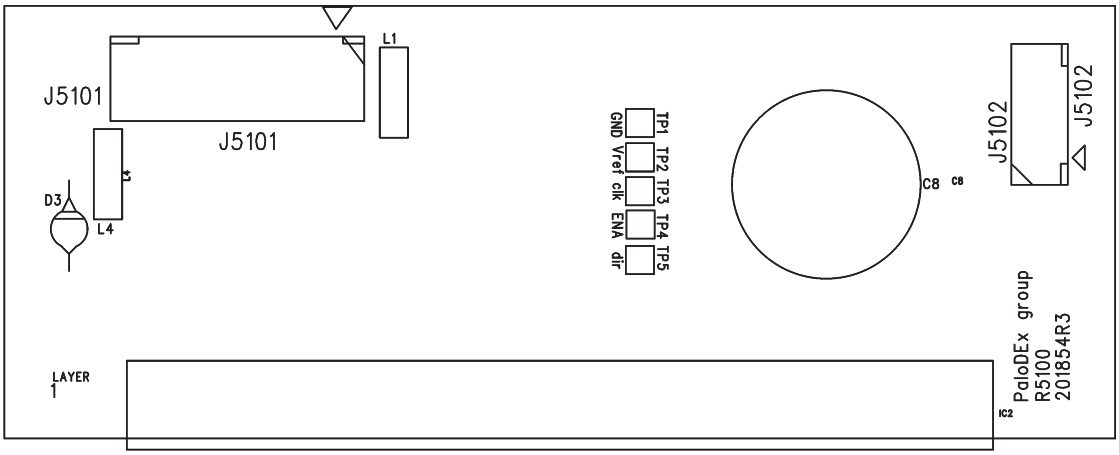

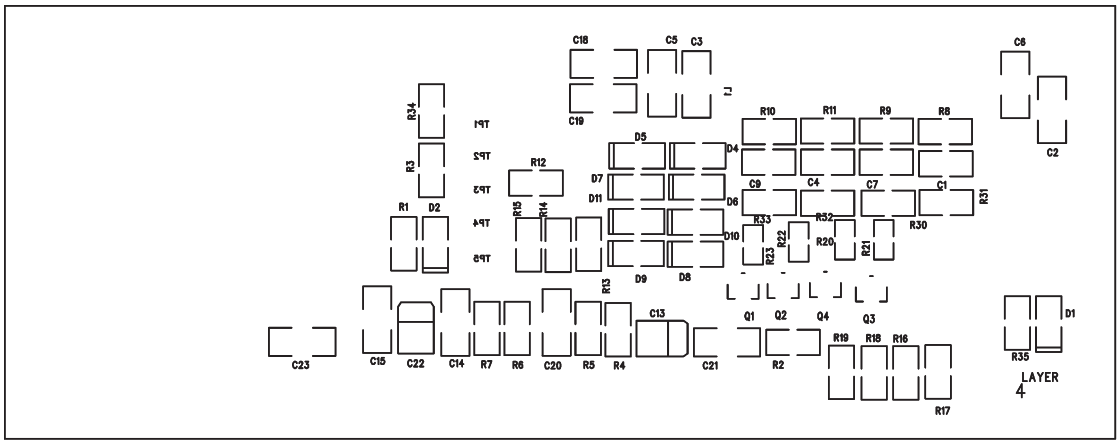

R5100

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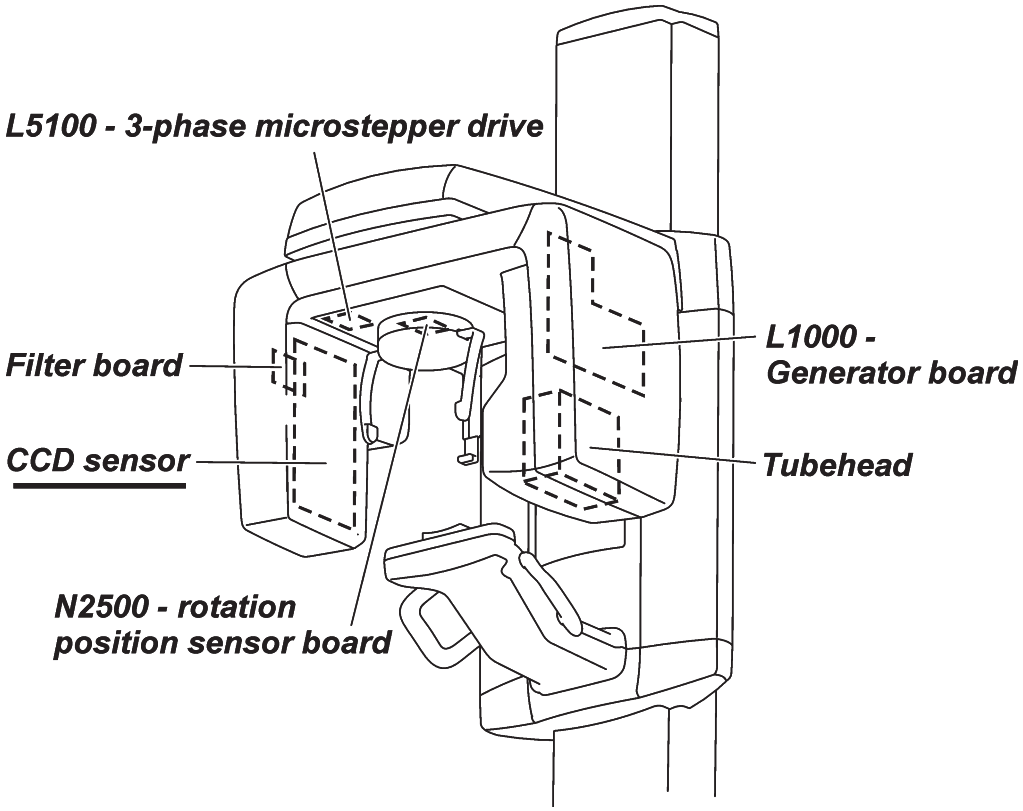
3.10 CCD Sensor / Filter board

CCD - Location

In rotating unit. To access, remove the sensor inner cover (see section 7.1).



CCD - Field replaceable parts

None. Inside the CCD Sensor there is the CCD Sensor board. The board cannot be accessed.

CCD - Description

CCD sensor converts X-ray radiation to visible light and and then the CCD semiconductor chips measure the intensity of the visible light. The analog signal is A/D-converted and sent in parallel data lines to the CPU board.

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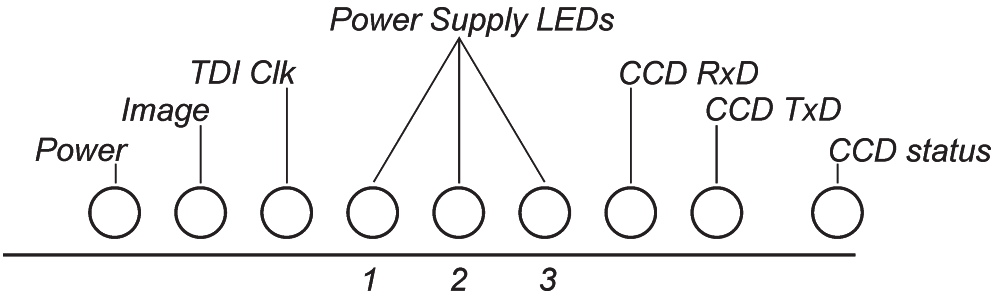
CCD - Indicator lights

Remove the covers from the CCD side of the rotating unit
On the rear of the CCD sensor there are a number of LEDs that indicate the status of the CCD sensor.



LED	Colour	Indicates
Power	Yellow	Indicates that the power signal is active.
Image	Yellow	Indicates image signal activity. It tells the CCD sensor A/D-converter to sample image data according to the TDI frequency.
TDI Clk	Yellow	Indicates that the clocking frequency of the CCD is available.
	Off	TDI frequency is between 0...50Hz.
	On	TDI frequency is between 100 Hz...1kHz.
	Flashing	TDI frequency is between 50...100Hz or above 1kHz.
Power Supply		Indicate the different voltages required by the CCD sensor. The microcontroller in the CCD sensor monitors the voltages and activates the LEDs accordingly. There are software set limits for the various supply voltages. The LEDs come on during image capture.
1	Yellow	+3.3V and +1.8V LEDs Supply voltages for the CCD clock controlling FPGA. The +3.3V is generated in L200 from +8V_ANA. The +1.8V step down is generated in CCD sensor board from +3.3V. LIMITS: +3.3V between +3.0 and +3.6V. +1.8V between +1.71V and +1.89V.
2	Yellow	Analog +5V LED. L200 generates this voltage from +8V_ANA. Supply voltage for AD-converters. LIMITS: between +4.5V and +5.5V

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D504851

3	Yellow	+15V, +3V and –9V LED L200 generates: +15V from +24V +3V from +8V_ANA -9V from the DC voltage of the 9VAC rectifier bridge CCD gate voltages LIMITS: +15V between +13.5V to +16.5V +3V between +2.4V and +3.6V -9V between -9.92V and -9.17V Another required voltage is µC +3.3V. It is used to power the microcontroller.
CCD TxD and CCD RxD		
	Yellow	Serial communication. In normal operation they flash intermittently. They indicate communication activity. If CCD RxD is off (passive CCD sensor), CCD TxD will also be off. **NOTE:** If CCD TxD is off, CCD RxD is on and the CCD status LED flashes during and after image capture it indicates that the CCD sensor tried to receive the image, but the transmit communication routine failed.
CCD Status	3-color	It indicates that the CCD is connected, all the software has been downloaded and it is ready to take an image.
	Green	Stand-by mode.
	Yellow	Image capture mode (power on).
	Red	In position but not yet ready, SW is being loaded.
	Red flashing	Fatal SW error / communication routine failure after an image has been taken. If this happens, switch the unit off for 10 seconds and then switch the unit on again.

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4. Troubleshooting

4.1 Initial checks

Restarting the unit

If the unit fails to operate, does not operate correctly or if an error code appears, switch the unit off, wait for a few seconds and then switch the unit on again. If the unit still does not operate correctly or the error message reappears, follow the troubleshooting procedures described here to correct the problem.

If there is a problem with image transfer, close and reopen the dental imaging software and/or restart the PC.

Error Codes

If the unit malfunctions or if it is used incorrectly an error code will appear on the main control panel.
There are two categories of error code:

- **H**, user errors, and
- **E**, system errors.

When an error code appears on the display the unit will stop working. The unit cannot be operated while the error code is on the display.
To clear an error code from the display, correct the error and then press any key on the main control panel (NOT the side control panel).
NOTE:
Error E18, display failure can only be seen on the service assistant.

Checking circuit boards

Circuit boards cannot be repaired in the field. On some boards some fuses can be replaced. But, if a board is faulty, replace it.

On most of the circuit boards there are indicator LEDs, that allow the operation of the board to be monitored, and test pins (TP), that allow the operation of the board to be checked. LED and test pin descriptions for each circuit board are in the section 3 Circuit Boards.
Use a digital multimeter (DMM) when checking boards.

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Checking cables and connectors

Visually check cables for mechanical damage, cuts, damaged insulation and twists. If a cable is damaged in any way replace it.

If there is no obvious mechanical damage to a cable but you think that it may be faulty, use a digital multimeter (DMM) to check the resistance of the different wires within the cable. An undamaged wire will have close to no resistance (>0 ohm), a damaged wire will have a high resistance value.

Make sure that all cables are correctly and securely attached to their respective connectors. Connectors must not be loose or misaligned. If the connector has a locking mechanism make sure that it is locked.

If you find a loose or misaligned connector, disconnect it and check for bent, broken or missing pins. If there is damage that can be easily repaired, for example straightening a bent pin, repair the damage and reconnect the connector. If the damage cannot be repaired replace the cable.
Note that if the connector on the board is also damaged, the board may also have to be replaced.

Power supply problems

Power supply problems are described in section - **4.2 Problems during start up**.

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4.2 Problems during start up

Nothing happens when the unit is switched on

The on/off switch light does not come on.

CAUSE A
Power cut.
SOLUTION A
Check to see if the power has been cut off.

CAUSE B
Unit not connected to the main power supply
SOLUTION B
Make sure that the unit is connected to the main power supply. Check the condition of the power supply cable. If it is damaged, replace it.

CAUSE C
The main fuses (2) have blown.
SOLUTION C
Disconnect the main power supply cable from the unit and then replace the main fuses (2). They are located below the main power supply cable at the rear of the column.
The fuse ratings are:
T6.3 H, SPT (220/230/240 VAC) or
T10A, SPT (100/115 VAC).
Case 5mm x 20mm, UL approved.

The on/off switch light comes on but the display does not come on.

CAUSE A
L900 (Control panel) is not receiving power or is faulty.
SOLUTION A
Check the supply of power to L900. Power is routed to L900 as follows:

1. Mains power, 230 VAC, is supplied to **L100 (Z-Motor Driver**.
   If L100 is receiving power lamp LA1 (on L100) will be on.
   If it is not, check the cables and connectors between the on/off switch and L100 (J105 and J106) and replace the cables if they are faulty.
   If the cables are okay, replace L100.

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D504851

2. L100 (Z-motor driver) supplies 230/115VAC to the **Generator Board**.
   Check that lamp LA1 on the Generator Board is on. If it is not, check the cable and connectors between L100 and the Generator board (X47) and replace the cable if it is faulty.
   If the cable is okay, replace the Generator board.

3. The Generator board supplies 230/115VAC to the **Transformer**.
   Check the cable and connectors between the Generator board (X45) and the Transformer and replace the cable if it is faulty.

4. The transformer supplies 18, 9, 8VAC to the **L200 (CCD Power supply)**.
   Check that the LEDs D1, D2 and D14 on L200 are on.
   If they are not on check fuse FH1 on the Generator Board and replace if blown.
   If the LEDs do not come on after replacing FH1, check the cable and connectors between the Transformer and L200 (J205) and replace the cable if it is faulty.
   If the cable is okay, check fuses F1, F2 and F3 on L200 (CCD Power supply) and replace if blown. If the indicator LEDs on L200 still still do not come on, replace L200.
   NOTE: If only one or two of the LEDs come on it indicates that the Transformer is faulty.

5. L200 supplies 24V to L900. Check that LED H1 is on (green). Check that LED H2 is on (green). If LEDs H1 and H2 are not on replace L900.

6. Check the cables between L900 and the LCD-display. If the cables are okay, replace LCD-display.

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Error E 5 (Line voltage out of limits)

CAUSE
Line voltage to high or low.
SOLUTION
The error code will clear automatically when the voltage returns to its normal level.
If the voltage is not stable where the unit is being used, you may have to instal a voltage stabilizer.
Check that LEDs D1, D2 and D14 on L200 are on.
If some of the LEDs do not come on check the fuses on L200. Replace any faulty fuses.

Error E 18 (Display not connected)

Check Service Assistant for information about this error code

CAUSE A
Cable to L200 faulty.
SOLUTION A
Replace cable.

CAUSE B
L200 faulty
SOLUTION B
Replace L200

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D504851

4.3 Problems while preparing the unit for an exposure

Image of emergency button appears on main display

CAUSE
The emergency switch has been pressed down.
NOTE: LED D4 (ESTOP on) on L100 will come on when the emergency switch is pressed down.
SOLUTION
Turn the emergency switch clockwise to release it.

The side control panel Return key does not work

CAUSE
The Membrane key panel is faulty.
SOLUTION
Press some of the other keys to see if they work correctly. If they do it indicates that the return membrane key is faulty and the membrane key panel must be replaced.

Error E 7 (Opto or r-motor failed during r-movement)

CAUSE
N2500 or R5100 or rotating unit stepper motor is faulty.
The rotating unit cannot position itself correctly and keeps on rotating, until the timeout (E 9) stops movement, because N2500 is faulty.
The rotating unit does not move when the R key is pressed.
SOLUTION
N2500 can be checked by using the service command "optotest", see section **Service Assistant and Service Functions**.
The **optotest** command displays values that indicate the position of N2500. When you manually rotate the rotating unit the values should change, sector 0, sector 1, sector 2 and sector 3, which indicates that the optosensors on the board are working and that N2500 is functioning correctly.
If the values do not change, N2500 or the cable from L1100 to N2500 is defective.
If N2500 is functioning correctly it indicates that there is a problem with the stepper motor.
Check LEDs DI and D2 on R5100. If they are on the stepper motor or cable from R5100 to the stepper motor is faulty.

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Rotating unit stop rotating, no error code

CAUSE A
Faulty R5100 or stepper motor.
SOLUTION A
Check LEDs DI and D2 on R5100. If they are on the stepper motor or cable from R5100 to the stepper motor is faulty.

Patient positioning light(s) do not come on

The patient positioning lights (lasers) come on when:
- the light key is pressed
- or the up or down key is pressed

One of lights does not come on.

CAUSE A
The light is faulty.
SOLUTION A
Check the cable and connector from the L100 (Z-motor driver) to the light and replace the cable and light if faulty.
Realign the light, refer to the installation manual.
If the cable is okay replace the L100 (Z-motor driver).

None of the lights come on.

CAUSE A
The emergency switch has been pressed down.
Image of emergency button appears on main display.
NOTE: LED D4 (ESTOP on) on L100 will come on when the emergency switch is pressed down.
SOLUTION A
Turn the emergency switch clockwise to release it.

CAUSE A
N100 (Z-motor driver) is faulty.
SOLUTION B
Check that L100 (Z-motor driver) is functioning by measuring the PLENA signal (J116, pin 4), 0>5VDC.
Replace L100 (Z-motor driver) if it is not functioning correctly.

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NOTE:
When LED D1, on L100 (Z-motor driver), is on it indicates that the board is receiving 5VDC from L200 (CCD power supply). If the LED D1 is not on there is a power supply problem.

CAUSE B (Unlikely)
All the lights are faulty.
SOLUTION B
Replace all the lights, they are connected to L100 (Z-motor driver) and then realign them. Refer to the installation manual.

Up/down (Z-motor) keys do not work

CAUSE A
The emergency switch has been pressed down.
Image of emergency button appears on main display.
NOTE: LED D4 (ESTOP on) on L100 will come on when the emergency switch is pressed down.
SOLUTION A
Turn the emergency switch clockwise to release it.

CAUSE B
Z-motor not receiving power.
SOLUTION B
Check to see if lamp LA1 and LED D1 on L100 are on. If they are not then check fuse F1. Replace if blown.
If after replacing fuse F1 lamp LA1 comes on but LED D1 still does not come on, replace L200.

If LA1 and D1 are on check the cable from L100 (J104) to the Z-motor. Replace if faulty.
If the cable is not faulty measure the AC voltage from the Z-motor connector, on L100, to the Z-motor. Press the UP/DOWN key and check that there is an AC-voltage. Note that you need to connect the DMM differently when running the unit in the Up direction and in the Down direction.
If no voltage can be measured, replace the Z-motor.

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CAUSE C
The side control panel (up/down keys) has failed
SOLUTION C
If D2 and D3 on L100 do not come on when the up/down keys are pressed it indictes that the side control panel or the cable from the control panel are faulty and must be replaced.

CAUSE D (Unlikely)
The Z-movement end microswitch (top or bottom has failed) and the mechanical Z-movement end stops have stopped the Z-carriage.
SOLUTION D
Check to see if D3 on L100 is on. If on it indicates that the top or bottom Z-movement end microswitch has not been activated.

Drive the vertical carriage away from the mechanical Z-movement end stops by using the SW switches on L100
DANGER - HIGH VOLTAGE!
Take great care when pressing the switches SW1, SW2, SW3 not to touch indicator lamp LA1 which is 230 VAC.
Press SW1 + SW2 simultaneously to drive the vertical carriage up and SW2 + SW3 simultaneously to drive vertical carriage down.
Replace the end microswitches.

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
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D504851

4.4 Problems during exposure

Nothing happens when the exposure button is pressed

CAUSE A
Fuse F1 on L200 has blown.
SOLUTION A
LED D2 on L100 indicates if the unit is receiving power. If LED 1 is not on replace fuse F1 on L200.

CAUSE B
Exposure switch failed.
SOLUTION B
Replace the exposure switch.

CAUSE C
Unit not in ready mode, tubehead cooling.
SOLUTION C
Wait for tubehead to reach the correct operating temperature.

Error code H1 (Exposure interupted)

CAUSE A
OPERATOR ERROR. The exposure button was released during an exposure.
SOLUTION A
Advise the operator to hold down the exposure button for the duration of the exposure.

CAUSE B
The exposure button failed while it was being pressed during an exposure.
SOLUTION B
Take a test exposure to see if the same error code appears again. If it does, replace the exposure button.

Reviewed: Lavonen Maria 27.05.10 13:15:33
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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

Error codes E0, E1 and E2

NOTE:
Error codes E0, E1, E2 all indicate that the tubhead and/ or Generator board are not functioning correctly.

E 0 (Tube arcing)
CAUSE
Tube arcing.
NOTE:
Check the tube fail LED (red) in the upper right corner of the Generator board. If it is on it indicates that the tube is arcing.
E 1 (tubehead voltage)
CAUSE
Tubehead voltage (kV) too high or too low.
E 2 (tubehead current)
CAUSE
Tubehead current (mA) too high or too low.
SOLUTION
First use the Service Assistant to check the mA and kV feedback signals from the tubehead to see if the tube voltage and current are correct (Software Check).
To do this open the Service Assistant (**Alt + Ctrl + shift + R**) and select **kVcheck**.
A list of mA and kV feedback values will appear. If the feedback values are correct :-

```
----------------------------------------
KV check is PASS
-
```

will appear at the bottom of the list.

If the feedback values are not correct use the **exp** service function to measure and compare the values (Refer to Service Assistant and Service functions in section 5).

Select an exposure time of 2000 ms (2 seconds) or greater so that the mAfb and kVfb ADC values can be measured.

CAUTION:
Protect yourself from radiation when carrying out this procedure.

Reviewed: Lavonen Maria 27.05.10 13:15:33
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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

Press and hold down the exposure button. The "actual" mAfb and kVfb ADC values will appear on the display next to "target" values.
If the "actual" values differ by less that 20% from the target values, the tubehead is working correctly.

If the "actual" values differ by more than 20% from the target values, it indicates that there is a problem and the tubehead must be recalibrated.

From the Service Assistant select **calib** and calibrate the tubehead.
NOTE:
Keep exposure switch pressed for the duration of the calibration program.
After recalibrating the tubehead check if the calibration was successful.

If the calibration is successful select the **exp** function again and confirm that the mA and kV feedback signals are correct.

If the calibration was unsuccessful and the unit still does not work correctly, check the hardware.

Hardware check
Remove the cables from the tubehead side of the rotating unit. Check the cables between the Tubehead and the Generator board. Replace them if they are faulty and then recalibrate (**calib**) the tubehead.

If recalibration is not sucessful, measure the feedback signals from the Generator board. From the Service Assistant select **exp**.

Connect a DMM to the TP14 (kVfb) and TP17 (GND) on the Generator board and take an expose.

Then connect the DMM to TP18 (mAfb) and TP17 (GND) and take another exposure.
The values for feedback signals should be as follows:
kVfb (66kV) = 3.0 V ±0.2 V (2.8 - 3.2)
kVfb (77kV) = 3.5 V ±0.2 V (3.3 - 3.7)
mAfb (10mA) = 2.0 V ±0.2 V (1.8 - 2.2)

Reviewed: Lavonen Maria 27.05.10 13:15:33
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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

If values for the feedback signals are not within the limits, and recalibration does not help, measure the reference signals from L400.

Connect a DMM to TP12 (kVref) and TP17 (GND) on L1000 and take an exposure.

Then connect the DMM to TP11 (mAref) and TP17 (GND) and take another exposure.
The values for the reference signals should be as follows: (These values are only "guidelines", and depend on the unit.)
kVref (66kV) = 3.0 V ±0.2 V (2.8 - 3.2)
kVref (77kV) = 3.5 V ±0.2 V (3.3 - 3.7)
mAref (10mA) = 2.0 V ±0.2 V (1.8 - 2.2)

If the reference values are correct, but feed back values are not, the Tubehead and/or the Generator board may be faulty and must be replaced.
If there are no reference signals check the cabling between the Generator board and L1100. Replace if faulty.

Error E 6 (Exposure timeout)

CAUSE A
Exposure timeout error, exposure more than 10 seconds.
SOLUTION A
If LED D6 on is not on L1200 has failed. If it is replace the Generator board.

Error E 10 (CCD initialization/configuration failure)

CAUSE
There is no serial bus connection or the CCD sensor could not configure itself.
SOLUTION
Check the condition of all the cables and connectors to/ from the CCD sensor as well as the cables from CPU to L1100 and cables between L1100 and L200. Also check that L200 functions correctly. Check that none of the fuses on L200 have blown.

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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

Error E 11 (CCD power failure)

CAUSE
Supply voltages to the CCD sensor were not within tolerances during imaging.
SOLUTION
Check the condition of all the cables and connectors to/ from the CCD sensor.
Check the voltages on L200 by checking the reference LEDs. Always measure the voltages from the test points. Note that the voltages are only on during exposure, so connect a jumper to J203.

Error E 12 (CCD line failure)

CAUSE
The image data flow from the CCD sensor to L1200 was interrupted during the exposure.
SOLUTION
Refer to the trouble shooting information given in error code E11.

Error E 13 (CCD DMA failure)

CAUSE
Problem with image capture on the L1200.
SOLUTION
Refer to the trouble shooting information given in error code E11.

Reviewed: Lavonen Maria 27.05.10 13:15:33
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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

4.5 Problems after exposure

Error E 4 (Tubehead too hot or too cold)

CAUSE A
The tube head has over heated or is too cold <5°.
SOLUTION A
Wait for the tubehead to cool down/warm up.
When the tubehead reaches the right temperature the error message will automatically disappear. Note that this could take over 45 minutes.
Note that you will not be able to clear the error message until the tube head has cooled to the correct temperature.
If the error message appears even if the unit has not been used a lot, switch the unit off and then on again.

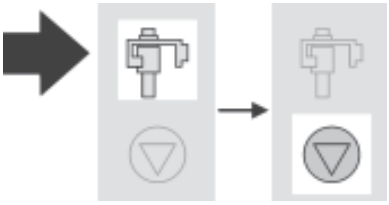
CAUSE B
The tube heat signal is missing.
SOLUTION B
If the error message never clears check the path of the tube heat signal. The tubehead and/or the generator board may be faulty and must be replaced.

Vertical white stripes on the image

Probably due to tube arcing.
Refer to the trouble shooting information given in error code E0.

Horizontal white stripes on the image

Recalibrate the CCD.



1. **PC:** Enable image capture.

2. **PC:** From the **service assistant** select the **imagecalib**.

3. Remove the chin rest and make sure that there is nothing between the sensor and tubehead.

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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

4. Protect yourself from radiation, and take an exposure.

5. Examine the image. It should be evenly grey all over with no granularity nor horizontal lines/ stripes. If the image is not evenly gray repear thet test. If there is no improvement in the image quality, replace the CCD sensor / Filter board.

4.6 Bad quality images

Bad quality images can be due to one or more of the following:

- incorrect patient positioning
- a badly aligned unit
- the CCD sensor is not calibrated

Incorrect patient positioning

If the unit is producing bad quality images, first make sure that the user is positioning the patients correctly.
For information on how to position the patient refer to the User's Manual.

A badly aligned unit

If patient positioning is correct, check the alignment of the unit.
For information on how to align the unit refer to the Installation and set-up manual.

The CCD sensor is not calibrated

See section **4.5 Problems after exposure - Horizontal white stripes on the image**.

Reviewed: Lavonen Maria 27.05.10 13:15:33
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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

5. Service Assistant and service functions

5.1 Using the Service assistant

The Service Assistant Utility includes a number of functions that allow the unit to be tested and configured during installation, set up and service.
Note that software cannot be downloaded using the service assistant.

To open the Service Assistant:

1. Switch the unit and PC on and then open Cliniview or the dental imaging software you are using.

2. Press **Alt + Ctrl + Shift + R** to open the Service Assistant.
   A warning will appear, click **OK**.
   The **Service Assistant** window will appear.

3. In the field at the bottom of the **Service Assistant** window key in **s** (case sensitive).

>s

   Press the **Enter** key. The **Service terminal** will appear.

4. In the field at the bottom of the **Service terminal** key in **help** or **h** (lower case).

>help (*or* h)

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

A list of functions will appear.
NOTE:
The list many vary according to unit version

CMD	DESCRIPTION (* available also in normal mode)
calib	calibrates generator references and preheat
imagecalib	takes a calibration image for calibrating the DSD
conf	display summary of configuration data
confccd	display summary of CCD configuration data
dap	set dose area product [<value>]
dc	takes dark current image
display	display power level
endu	endurance test, drives rotating unit 75 rounds
exp	exposure (<time>) in milliseconds, default is 1000
expcnt	exposure counter, use [<clear>] option to clear it
help	display info on command (‘help [cmd]’ or ‘h [cmd]’)
ip	configure ip address
kv	set default kV [<kV value>]
kVcheck	test kV/mA combinations
log	service log [<all> <clear> <newest> <statistics>]
logsign	make a service signature for current events
mac	print mac address
maincalib	calibrates main voltage high and low limits parameters: <nominal voltage> <current voltage>
optotest	prints optosensor values for 30 seconds
patt	generates test pattern from CCD module
prog	set default program [<pan> <ped> <tmj> <bw> <test>] (and overrides kV and set it back to default)
quit	quit service terminal
reset	software reset
restore	restore factory configuration
restgen	restore generator default values
serno	configure serial number (and MAC accordingly)
status	retrieves status and updates clock*
stillmode	still image exposure mode
warmup	tubehead warmup before first use

```
>
```

5. To select a function key in the function name, for example **exp**, into the field at the bottom of the **service terminal**.

```
>exp
```


Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

Press **Enter**.
Information about the selected function will appear at the bottom of the list of functions.

If a value can be changed or a option selected, key in the new value or select the new option, and then press **Enter** again.
If the function performs some other task, follow the instructions given.

6. To exit the **service terminal**, key in **quit**.

quit

Then press **Enter**.

5.2 The Service commands

COMMAND	DESCRIPTION
calib	**calibrates generator references and preheat** Calibrates the voltage (kV), current (mA) and prehear (mApreh) reference values for the tubehead and generator board. This calibration procedure must be carried out when the unit is installed and whenever the tube head and/or generator board are replaced. **CAUTION:** **Protect yourself from radiation when carrying out this procedure.** Press and hold down the expossure button for the duration of the procedure, which will last up to three minutes. During the calibration procedure you will hear the exposure warning signal and calibration values, current at the start and calibrated at the end, will appear on the display. When the calibration procedure is successful completed the message, **CALIBRATION WAS SUCCESSFUL** will appear.

Reviewed: Lavonen Maria 27.05.10 13:15:33
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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

Exit (quit) the service assistant.

NOTE:
If the calibration procedure is not successful the message,
!!!!! Calibration was NOT successful !!!!!
will appear.

If this happens, reset the generator, refer to the **restgen** service command for information on how to do this, and then repeat the calibration **(calib)** procedure.
If the second calibration procedure is not successful check the cables, the tube head and/or generator board and L1100. Replace any faulty baords.

imagecalib **takes a calibration image for calibrating the DSD / CCD / DSD driver**

Takes a calibration image.

conf **display summary of configuration data**

Displays all the current configuration parameters of the unit. The figures in brackets (1) are factory settings.
If you wish to restore the factory settings use the **restore** command.

NOTE:
default program 1 = adult pan, 2 = child pan, 3 = TMJ and 5 = Test.

confccd **display summary of CCD configuration data**

Displays the factory and current configuration parameters of the CCD sensor. These values are for information only.

dap **set dose area product [<value>]**

Displays the dose area product (DAP) calibration value.

Reviewed: Lavonen Maria 27.05.10 13:15:33
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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

dc **takes dark current image (dc = dark current)**

Is used to check if the CCD sensor (camera) is working.
Press the "Return" key to start the check.
During the check a series of values will appear in the service assistant window.
When the check is complete the text:
- CAMERA stop
will appear and then an image.
When the sensor is working correctly the vertical centre of the image will be slightly gray because of noise.

NOTE:
If an image does not appear, then the CCD sensor is faulty.

display **display power level**

Sets the power level of the display.
<1> turns the display off
<2> is low power
<3> is mid power
<4> is full power

endu **endurance test, drives rotating unit 75 rounds**

Automatically drives the rotating unit through 75 rotation cycles. No radiation in generated during rotation.
This command is used during factory testing.

exp **exposure (<time>) in milliseconds, default is 1000**

Generates x-rays. The CCD sensor is not activated and the the rotating unit does not move.
It is used to check the beam alignment during unit installation (refer to the Installation manual for more information), and to trouble shoot the tubehead and generator board.

CAUTION:
Protect yourself from radiation when using this function.
The default exposure time is 1000 ms (when "exp" is keyed in). If you wish to have a longer exposure time key in "exp" and them enter a value, for example:

```
>exp 3000
```


Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

will result is a exposure time of 3000 ms. The minimum value you can key in is 100 ms and the maximum is 10000.

Press and hold down the exposure button to activate x-rays.

If exposure times of 1000 ms or longer are used, the mAfb and kVfb ADC values will appear.

To exit the command key in **q** and then press **Enter** or press the **RETURN** key on the unit control panel.

NOTE:
The kV value used for the exposure will be the one selected before entering the service mode. The kV value cannot be changed while the unit is in the service mode. If you wish to change the kV, you must exit the service mode.

NOTE:
The **"still"** command, described later, generates x-rays and activates the CCD sensor but the rotating unit does not move.

expcnt **exposure counter, use [<clear>] option to clear it**

Displays the total number of exposures taken with the tubehead.

To zero the exposure counter enter clear,

```
>expcnt clear
```

and then press **Enter**.

NOTE:
Always zero the exposure counter when the tubehead is replaced.

help **display info on command ('help [cmd]' or 'h [cmd]')**

Displays the service command list and information about the commands.

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

ip **configure ip address**

Displays the current IP address of the unit.

To change the IP address enter the new one,

> ip *aaa.bbb.ccc.ddd (the new IP address)*

and then press **Enter**.

After changing the IP address of the unit, communication between the unit and the PC will be lost and the link to the PC will have to be reconfigured. Refer to section, **3.5 Configuring the communication link to the PC**, in the installation manual.

NOTE:
The IP address can also be reset using the driver tools

kv **set default kV [<66> <70> <73> <77>]**

Allows the kV value that is automatically selected when the unit is switched on to be changed. There are four settings, 77 kV (the factory setting), 73, 70 and 66 kV.

To change the kV value, enter the new one (66),

> kv 66

and then press **Enter**.

kVcheck **test kV/mA combinations**

Displays feedback values of all kV/mA combinations.

log **service log [<all> <clear> <newest> <statistics>]**

Displays exposure logs.
There are several log options:
<all> = (default) display the complete log
<clear> erase all log entries
<newest> display the latest log entry
<statistics> display the log statistics.

To select one of the log options enter the required command,

> log clear

and then press **Enter**.

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

logsign **make a service signature for current events**

Allows a short note to be added to a log entry.

Add the note,

> logsign *Note .....*

and then press **Enter**. The note will appear in the log.

mac **print mac address**

Displays the current MAC address of the unit.

To change the MAC address enter the new one,

> mac *aa.bb.cc.dd.ee.ff (the new MAC address)*

and then press **Enter**.

After changing the MAC address of the unit, communication between the unit and the PC will be lost and the link to the PC will have to be reconfigured. Refer to section, **3.5 Configuring the communication link to the PC**, in the installation manual.

NOTE:
DO NOT change the MAC address unless you know what you are doing. The MAC address is dependent on the serial number and is set at the factory.

mainscalib **calibrates main voltage high and low limits**
parameters: <nominal voltage> <current voltage>

Recalibrates the upper and lower limits of the unit if L1200 CPU board is replaced.

Key in the voltage of the unit and then measure the actual supply voltage (from the plug) and then enter this value.

>mainscalib 230*(nominal voltage)* 225*(actual voltage)*

and then press **Enter**.

The upper and lower voltage limits will be automatically calibrated.

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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

optotest **prints optosensor values for 30 seconds**

Allows N2500 to be checked. Optosensors on N2500 monitor the position of the rotating unit.

The "optotest" command displays, for 30 seconds, values that indicate the position of N2500. When you manually rotate the rotating unit the values should change,

```
sector 0
sector 1
sector 2
sector 3
```

which indicates that the optosensors on N2500 are working and that the board is functioning correctly. If the values do not change N2500 or the cabling is defective.

patt **generates test pattern from CCD module**

Produces a test pattern image from the CCD.

The pattern shows a number of two-tone gray vertical lines. These indicate that the data lines to the CCD sensor are working correctly.

Reviewed: Lavonen Maria 27.05.10 13:15:33
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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

prog **set default program [<pan> <ped> <tmj> <test> <test>] (and overrides kV and set it back to default)**

Allows the default exposure program, the program automatically selected when the unit is switched on, to be selected.
The choices are:
<pan> = (default) panoramic program
<ped> = child (reduced width) panoramic program
<tmj> = temporomandibular joint program
<bw> = bitewing
<test> = the test mode.

To select a new option enter the required command,

```
> prog ped
```

and then press **Enter**.

NOTE:
The appropriate kV for the selected progam will be automatically selected.

quit **quit service terminal**

Exits and closes the service terminal.

reset **software reset**

Reboots the unit.

restore **restore factory configuration**

Restores the configuration settings to the default factory settings. You must key in **restore configuration**.

```
> restore configuration
```

restgen **restore generator default values**

Restores the original default settings of the generator. This should be used if the calibration (**calib**) command was unsuccessful.

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

serno **configure serial number (and MAC accordingly)**

Displays the serial number of the unit.

> serno IV XXXX

and then press **Enter**.

NOTE:
The serial number can be reset when the CPU is replaced. The serial number can only be set once.

status **retrieves status and updates clock***

For factory use only.

stillmode **still image exposure**

Generates x-rays and activates the CCD sensor but the the rotating unit does not move.
It is used to check the beam alignment during unit installation (refer to the Installation manual for more information).

CAUTION:
Protect yourself from radiation when carrying out this procedure.

Press and hold the exposure switch to take a still image exposure.

NOTE:
The **"exp"** command, described earlier, generates x-rays but does not activate the sensor or move the rotating unit.

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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

warmup **tubehead warmup before first use**

Initializes the tubehead. Must be used when the unit is installed or if the unit has not been used for a long time.

CAUTION:
Protect yourself from radiation when carrying out this procedure.

Press and hold the exposure switch until the procedure is complete. The procedure may take some minutes.

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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

6. Updating unit firmware, core and display graphics

NOTE:
If the order in which the firmware is updated is important, it will be indicated with the firmware release.

6.1 The unit firmware

Whenever a new version of the unit firmware is released, Instrumentarium Dental Support will make this information necessary and supply the necessary files.

The firmware in the unit can only be updated using the Service Teminal (s2terminal program).
(The firmware cannot be updated using the CV Service Assistant!).

1. Create a new folder in the PC connected to the unit. Make sure that CV or the dental imaging program being used is closed, and then copy the new firmware and s2terminal files into the new folder.

   The firmware file is:
   op30fw1.04.srec

   and the s2terminal files, required to transfer the files to the unit, are:
   s2terminal.exe (Version 1.XX or later).

   s2.dll (Version 1.XX or later).

   W32N50.dll

2. From Windows Select: **Start** / **Run**, and then type into the “Open” -field: **<cmd>** and click **OK**. The Command Prompt window will appear.

3. Go to the folder where the new firmware and s2terminal files are located.
   (Type **<s2terminal>** into the command prompt to see the instructions for the command syntax.)

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

4. Start the s2terminal program using the IP address of the unit:
   Type **<s2terminal 194.9.227.251>** (starts the s2terminal for a unit with the IP 194.9.227.251) and press "Enter".

   If the IP-address is correct and the s2terminal program is able to connect to the unit, the following terminal output will appear as follows:
   C:\OP30>s2terminal 194.9.227.251
   S2Terminal v1.1 (or above)
   Software version X.XX
   Core version XX
   Serial number IVXXXXXX

5. Type **<xh>** into the command prompt and press "Enter" to see the instructions for the command syntax.
   xs 1.04

6. Type **<xs>** and press "Enter" to start upgrading the firmware.

7. When the upgrade is successful, the following output will appear:
   xs
   Transferring program...
   Waiting for flashing.....
   Status command transfer error.
   Login fail (no connection).
   Login fail (no connection).

   NOTE:
   It is normal for the “Login fail ...” message to appear several times.

   Software version X.XXX
   Core version XX
   Serial number VXXXXXX

8. Enter **<xq>** and press "Enter" to quit the s2terminal program.

9. Restart the unit to make sure that it functions correctly.

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D504851

6.2 Updating the core

It is not necessary to systematically upgrade the core in all OP30 units, unless Instrumentarium Dental Technical Service requests it.

Core upgrading is done using s2terminal -program (Core cannot be updated with the CV Service Assistant!).

1. Make sure that CV or the dental imaging program being used is closed. Copy the core file to the same dedicated folder as the s2terminal files.
   The core file name is **op30coreXX.rbf** where XX is the core version.

2. Start the s2terminal program using the IP address of the unit:
   Type **<s2terminal 194.9.227.251>** (starts the s2terminal for a unit with the IP 194.9.227.251).

3. Enter **<xh>** and press "Enter" to display the help menu.

4. Enter **<xc XX>** (where XX is the version number in the core filename) and press "Enter" to start the firmware upgrade.
   For example: if the core filename is **op30core26.rbf**, the command will be **<xc 26>**.

5. Restart the unit to make sure that it functions correctly. and check that the “Core version XX” –output has changed to the new version (the new core automatiaclly loads at startup).

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6.3 Updating the GUI graphics

Graphics are updated by using the s2terminal -program (Graphics cannot be updated with the CV Service Assistant!).

1. Make sure that CV or the dental imaging program being used is closed.
   Copy the graphics file to the same dedicated folder as the s2terminal files.
   Graphics file name is **ImagesIV.bin**.

2. Start the s2terminal program using the IP address of the unit:
   Type **<s2terminal 194.9.227.251>** (starts the s2terminal for a unit with the IP 194.9.227.251).

3. Enter <xh> and press "Enter" to display the help menu.

4. Enter **<xg>** and press "Enter" to start the graphics upgrade.

5. Restart the unit to make sure that it functions correctly. Test different views to see that the display functions properly.

Reviewed: Lavonen Maria 27.05.10 13:15:33
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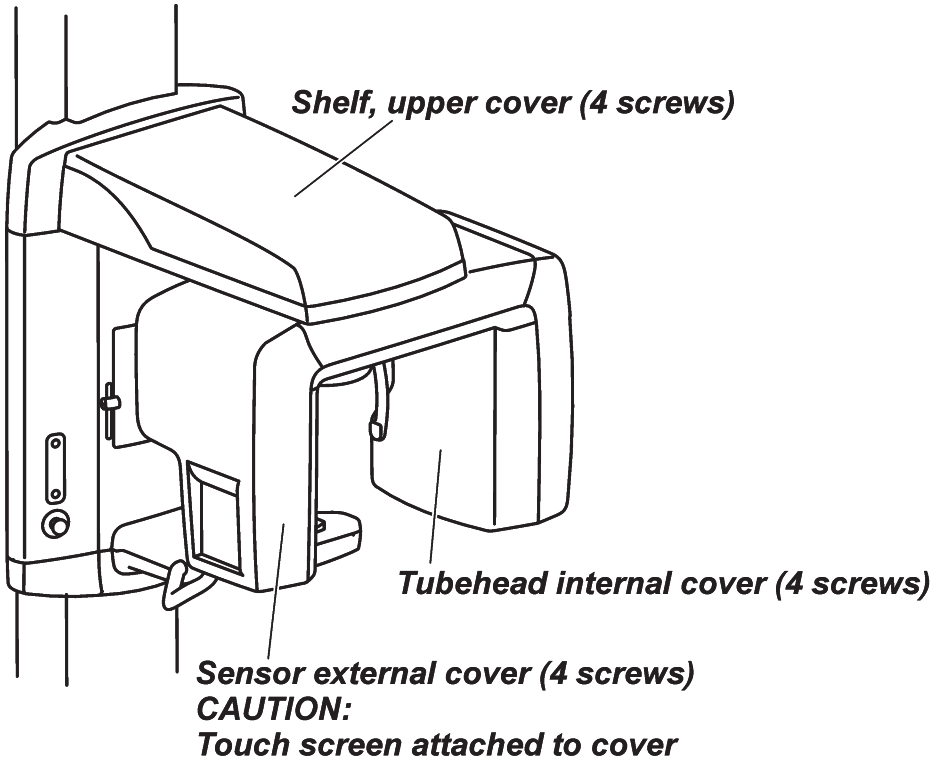
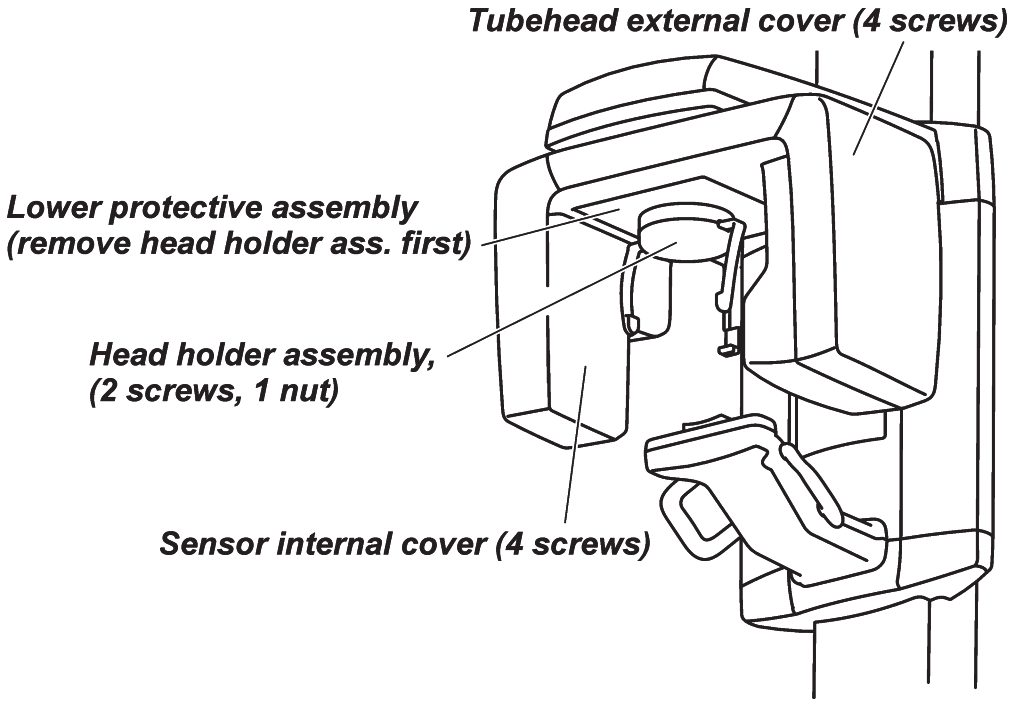
7. Replacing parts.

7.1 Removing covers


Shelf, upper cover (4 screws)
Tubehead internal cover (4 screws)
Sensor external cover (4 screws)
CAUTION:
Touch screen attached to cover


Tubehead external cover (4 screws)
Lower protective assembly
(remove head holder ass. first)
Head holder assembly,
(2 screws, 1 nut)
Sensor internal cover (4 screws)

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
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D504851

7.2 Replacing the tubehead

Tools required

The normal installation and alignment tools.

Replacement parts

- New tubehead
- Tubehead label

Replacing the tubehead

1. Switch the unit off and disconnect it from the main power supply.

2. Remove the ***tubehead internal cover*** and the ***tubehead external cover*** from the tubehead side of the rotating unit.

Reviewed: Lavonen Maria 27.05.10 13:15:33
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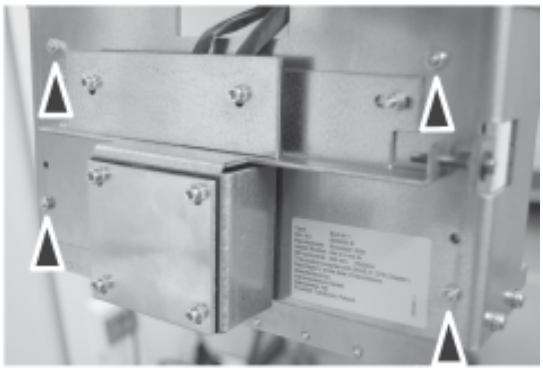
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

3. Disconnect all cables and the ground cable from the **tubehead**.

4. Remove the four (4) nuts that hold the **tubehead** to the **rotating unit frame** and remove the tubehead.



5. Attach the **new tubehead** to the rotating unit frame with the four (4) nuts.

6. Reconnect all the cables.

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Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

Calibrating the tube head and checking the alignment

1. Reconnect the unit to the power supply and then switch the unit on.

2. Open the service assistant.
   Carry out the **warmup** procedure and then **calib** procedure.
   Also set the exposure counter to zero (**expcnt clear**).

3. Realign the unit (refer to section **8. Aligning the unit**).

4. Open the **setup** page in Cliniview. Choose the calibration mode and take the calibration image (use the calibration filter supplied with the unit).

5. Replace the covers.

6. Attach the new tubehead label to the underside of the tubehead side of the rotating unit.

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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

7.3 Replacing the CCD sensor

After replacing the CCD sensor, realign the unit (refer to section **8. Aligning the unit**).

7.4 Replacing the collimator

After replacing the collimator, realign the unit (refer to section **8. Aligning the unit**).

7.5 Replacing circuit boards

1. Switch the unit off and disconnect it from the power supply.

2. Remove the appropriate cover(s) so that you can access the circuit board you wish to replace.

3. Disconnect all the cables from the circuit board, remove the board and install the new one.

L900 Display adaptor - additional instructions

After replacing L900 Display adaptor (rev 6 and later) check that the jumpers on the board are in the correct positions for the touch display installed in the unit.
For touch display:
- OPTREX T-55265GD057J-LW-ACN
SW1 = on, SW2 = on

For touch display:
- SHARP LQ057Q3DG01
SW1 = off, SW2 = on

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D504851

L1000 Generator board - additional instructions

After replacing the board use the Service Assistant to recalibrate the unit:
- calib
Refer to section **5. Service Assistant and Service Functions**.

L1100 Connector board - additional instructions

After replacing the board use the Service Assistant to recalibrate the unit:
- calib
Refer to section **5. Service Assistant and Service Functions**.

L1200 CPU board - additional instructions

After replacing the board use the Service Assistant to recalibrate the unit and the power supply limits and reset the serial number.
- calib
- mainscalib
- serno
Refer to section **5. Service Assistant and Service Functions**.

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See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
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D504851

8. Aligning the unit

After replacing one of more of the following: tubehead, collimator, CCD sensor, the alignment of the unit must be checked and if required adjusted.

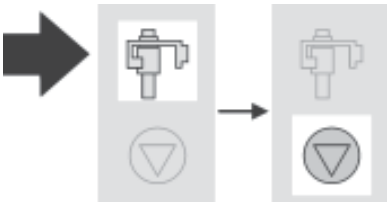
8.1 Removing the covers

1. Remove the covers from the unit if they have not been removed already.

8.2 Checking and Aligning the CCD Sensor

1. Switch the unit and PC on.

2. **PC:** Open Cliniview (or the digital imaging software you are using) and open a patient card where the alignment images can be stored.



3. **PC:** Enable image capture.

4. **PC:** Make sure that the **stillmode** in the **service assistant** is still selected.

5. **Protect yourself from radiation**.
Press and hold down the exposure button to take an exposure.

6. The image should show a vertical black line (the beam) in the middle of a vertical light gray area (the CCD aperture). Both the beam (black line) and the CCD aperture (light gray area) must be vertical and the bottom edge of the beam (black line) must be between 0.1 and 2mm from the bottom edge of the image.

Reviewed: Lavonen Maria 27.05.10 13:15:33
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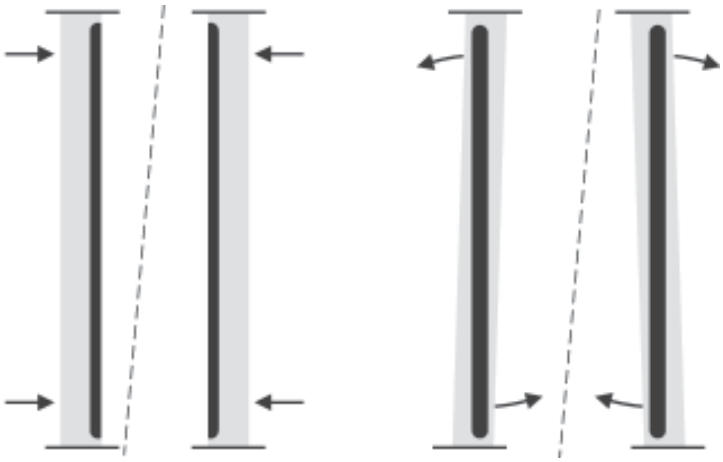
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

If the beam (black line) is not in the middle of the CCD aperture (the gray area), the position of the CCD Sensor must be adjusted to the right or left.

If the CCD aperture (gray area) is not vertical, the CCD sensor must be rotated slightly until it is vertical.



Screws

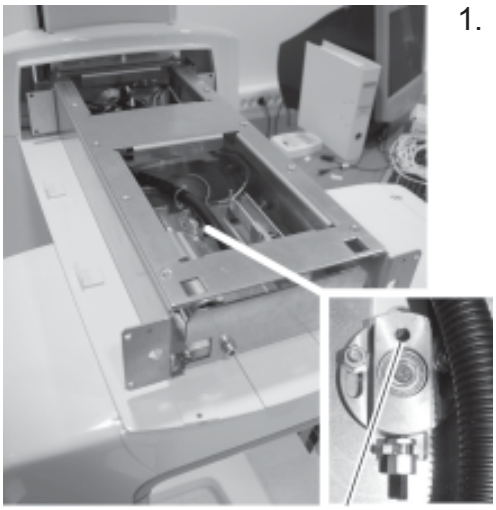
Nuts

7. Loosen the nuts (4) that hold the CCD sensor in place and then adjust its position with the screws (2) on the left-hand side.

   Adjust and recheck the position of the CCD sensor until the beam is vertical and centered in the middle of the CCD aperture.

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

8.3 Checking and adjusting the position of the collimator



1. Manually rotate the Rotating Unit to the Patient In/Out (**PIO**) position (rotating unit parallel to the **front** of the upper shelf and the tubehead (t/h) on the **right**.
   Insert a 4 mm hexagon socket wrench into the locking hole in the guide pin assembly to hold the rotating unit in position.

2. Attach the **alignment cone assembly** to the chin support.

3. **Protect yourself from radiation**
   Press and hold down the exposure switch to take an exposure.

Reviewed: Lavonen Maria 27.05.10 13:15:33
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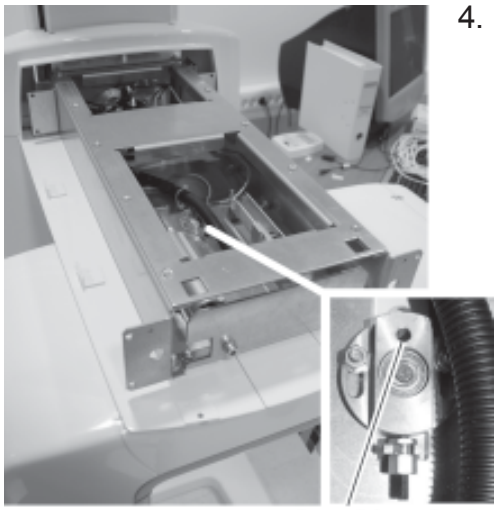
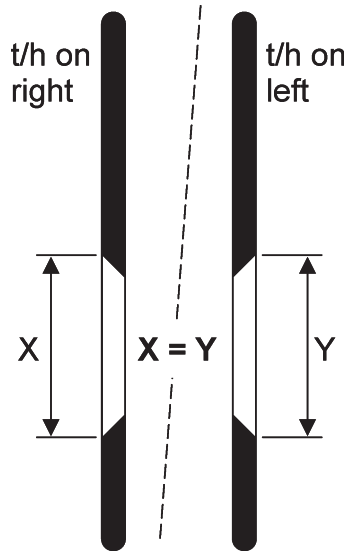
Approved
D504851



Locking hole

4. Remove the hexagon socket wrench from the locking hole and then manually rotate the rotating unit 180º so that the tubehead (t/h) is on the **left** (opposite the PIO positon).
Reinsert the hexagon socket wrench into the locking hole in the guide pin assembly to hold the rotating unit in position.

5. **Protect yourself from radiation.**
Press and hold down the exposure switch to take an exposure.



6. Compare the two images just taken.
Use the measuring tools in the dental imaging software to measure the white sections (the alignment cone) in the middle in the middle of the dark exposed areas.

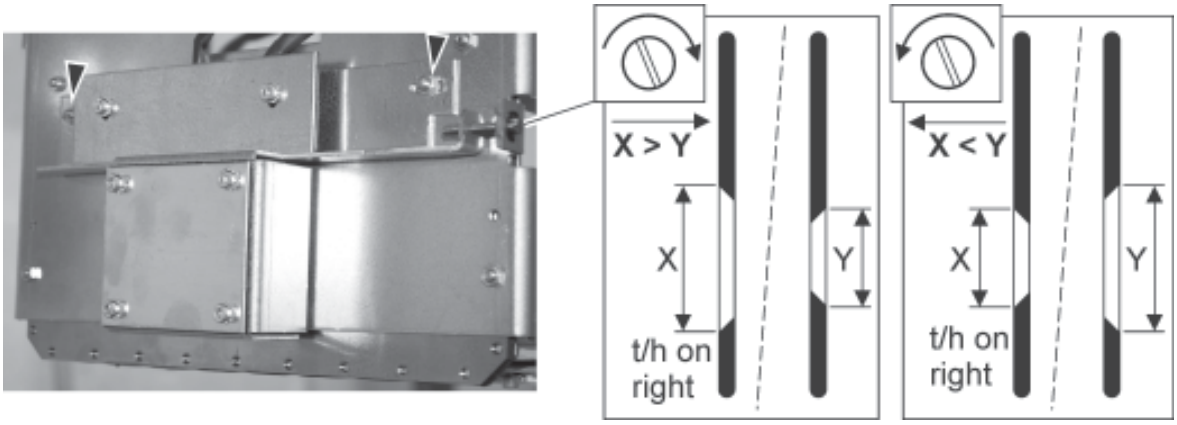
   If the collimator is in the correct position the white section in the images will be the same size (± 0.25mm).

   If the white section in the "tubehead on right" image is **greater** than the white section in the "tubehead on left" image, the collimator must be moved to the **right** (turn the collimator adjusting screw **clockwise**).

   If the white section in the "tubehead on right" image is **less** that the white section in the "tubehead on left", the collimator must be moved to the **left** (turn the collimator adjusting screw **counter-clockwise**).

Reviewed: Lavonen Maria 27.05.10 13:15:33
Approved: Raivonen Veli-Pekka 27.05.10 17:30:18
See the PaloDEx Group Oy PDM system to determine the status of this document. Printed out: 08.10.12 11:03:37
Approved
D504851

To adjust the collimator loosen the nuts (2) that hold the collimator assembly in position and the adjust the left/right position of the collimator with the screw (1) on the right-hand side.



7. Recheck the position of the collimator and readjust if necessary.

8. Remove the hexagon socket wrench from the locking hole when you have completed this adjustment.

Reviewed: Lavonen Maria 27.05.10 13:15:33
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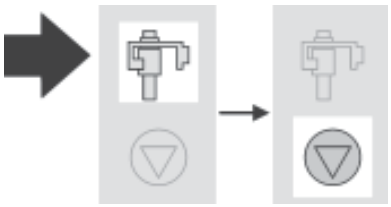
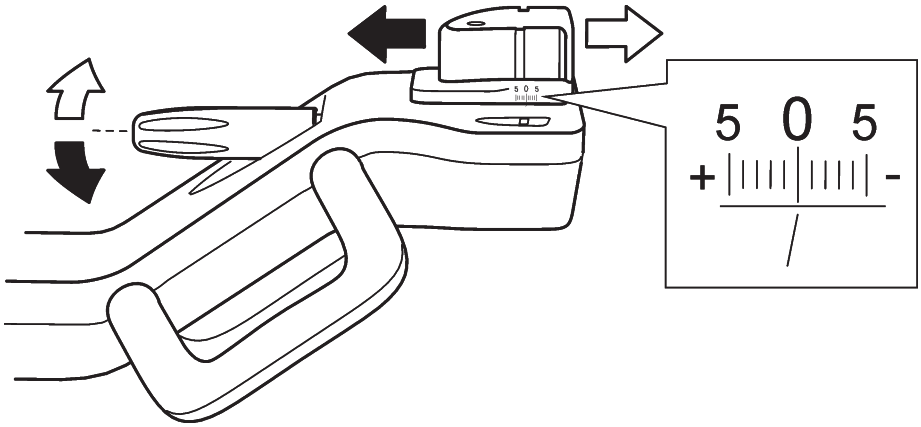
D504851

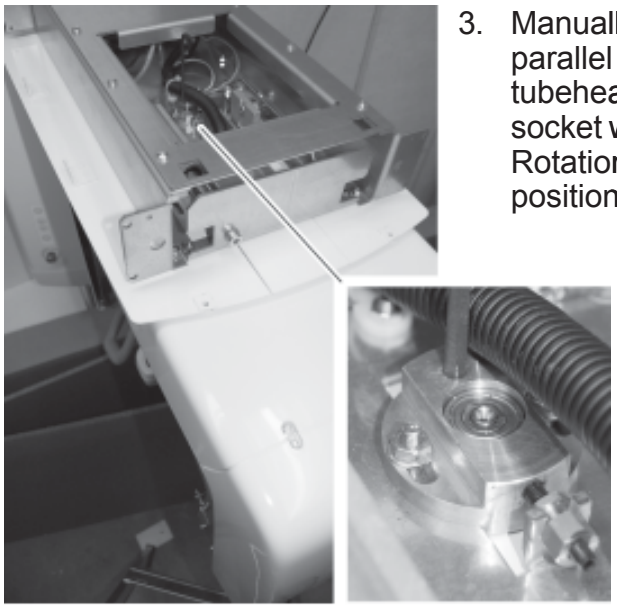
8.4 Checking and adjusting the Chin Support



1. **PC:** Enable image capture.

2. Make sure that the chin support is in the 0 position and then attach the **alignment cone assembly** to the chin support.





3. Manually rotate the Rotating Unit so that it is parallel to the **side** of the upper shelf and the tubehead is at the front. Insert a 4 mm hexagon socket wrench into the locking hole in the Rotation bearing to hold the rotating unit in position.

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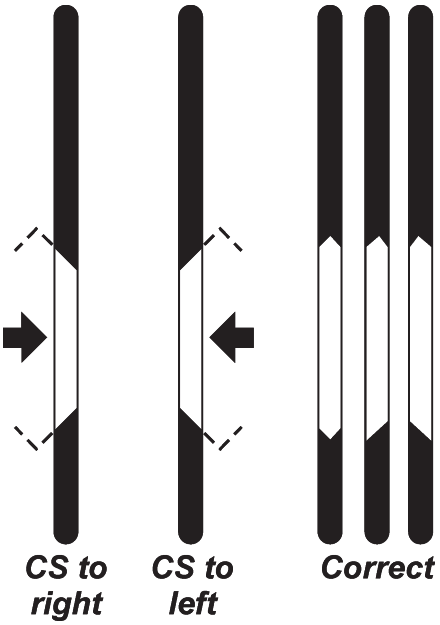
Approved
D504851

4. **Protect yourself from radiation.**
Press and hold down the exposure switch to take an exposure.



5. Examine the image.

If the chin support (CS) is in the correct position the top point of the alignment cone will be in the center of the exposed area.

If you only see the sides of the alignment cone, the chin support must be moved to the left or the right.

To adjust the positon of the chin support loosen the two screws that hold it in place (on the underside of the chin support) and adjust accordingly.

IMPORTANT NOTE:
Check and if necessary adjust the position of the midsagittal light if you adjust the position of the chin support.

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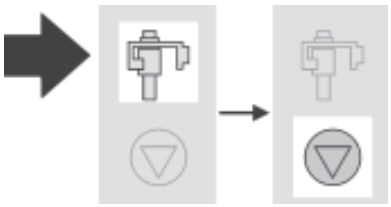
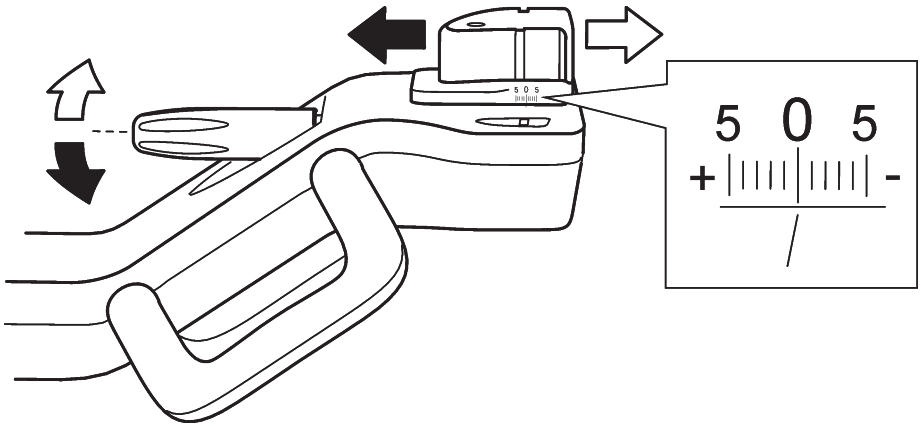
D504851

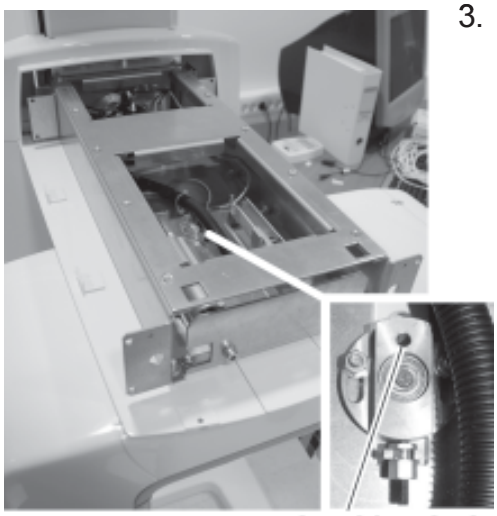
8.5 Checking and adjusting the focal trough



1. **PC:** Enable image capture.

2. Make sure that the chin support is in the 0 position and then attach the **alignment cone assembly** to the chin support.





Locking hole

3. Manually rotate the Rotating Unit to the Patient In/Out (**PIO**) position. Rotating Unit parallel to the **front** of the upper shelf and the tubehead (t/h) is on the **right**.
Insert a 4 mm hexagon socket wrench into the locking hole in the Rotation Bearing to hold the Rotating Unit in position.

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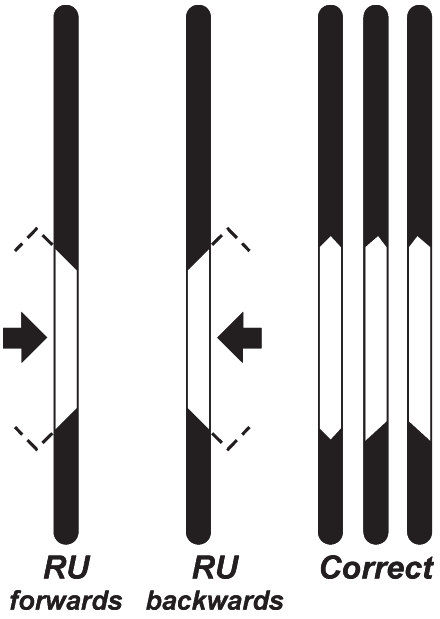
Approved
D504851

4. **Protect yourself from radiation.**
Press and hold down the exposure switch to take an exposure.

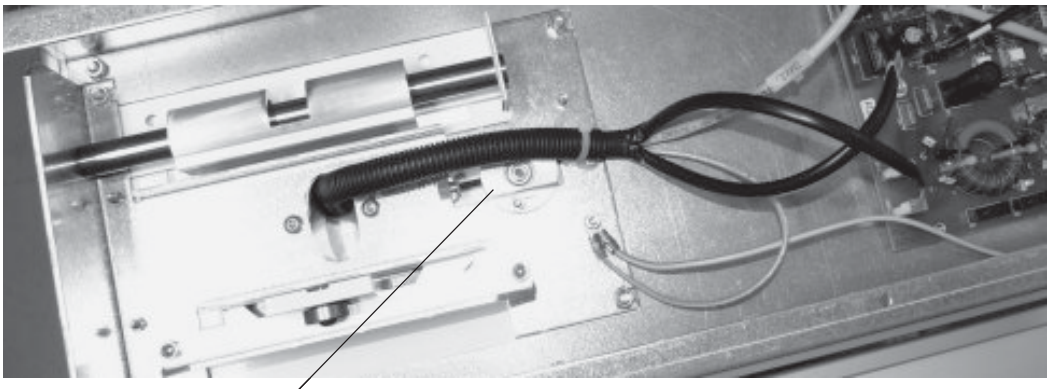


5. Examine the image.

If the focal trough is in the correct position the top point of the alignment cone will be seen in the center of the exposed area.

If you only see the sides of the alignment cone, the focal trough is not in the correct position and it must be adjusted by mobing the rotating unit RU) backwards or forwards.

To adjust the positon of the rotating unit loosen the two nuts that hold the rotation bearing in place.



Turn the adjusting screw to move the the Rotating Unit backwards or forwards.
Counter clockwise will move the Rotating Unit towards the column and clockwise away from it.

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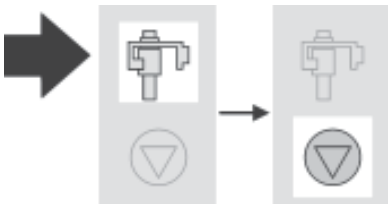
Approved
D504851

8.6 Recheck the alignment

1. Take a ball-pin exposure to confirm that the unit is now correctly aligned. Refer to the **Installation Manual** section **5. Checking the alignment**.

8.7 Calibrating the CCD sensor



1. **PC:** Enable image capture.

2. **PC:** From the **service assistant** select the **imagecalib**.

3. Select 66 kV.

4. Protect yourself from radiation, and take an exposure.

5. Examine the image. It should be evenly grey all over with no granularity nor horizontal lines/ stripes. If the image is not evenly grey repeat the calibration until it is.

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